PDP-11/60
Configuring
Guide

d|i|g|i|t|a|l

OEM PRODUCTS GROUP
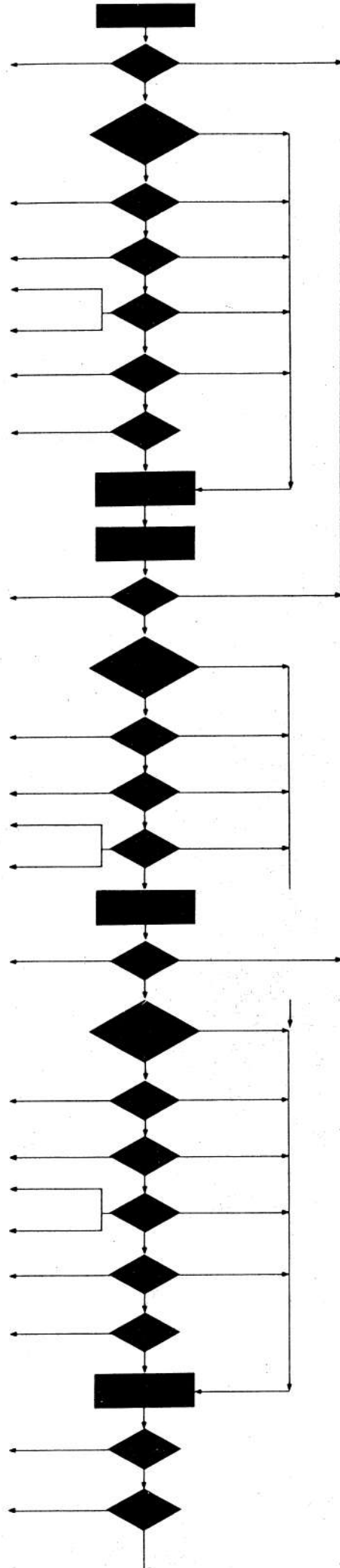
July 1978

digital

The OEM marketplace is evolving rapidly . . . and DIGITAL's PDP-11/60 is helping set the pace.

DIGITAL is pioneering a quiet revolution in the OEM computer marketplace. With the availability of realistically-priced minicomputer bulk storage devices, the traditional dedicated control CPU can now not only gather information from the real world, but can also store it economically and retrieve it quickly.
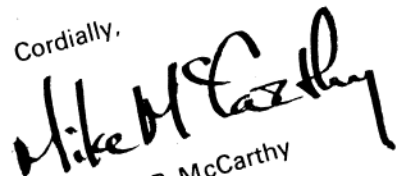
Multitask operating systems and high-performance video terminals are the next major evolutionary steps, making the information gathered by the computer available to people.

This is creating entirely new business opportunities for OEMs . . . products and systems delivering customized computing services to working people in our modern economy – in manufacturing, in testing, in finance – in every area of human endeavor.

The PDP-11/60 targets this new segment of the OEM marketplace. It offers capabilities you need now:

- The CPU power needed to support complex applications
- The software executive and development tools you need to get to market quickly
- The up-time needed when people depend on your product
- The packaging, attractive as well as practical, designed for your customer's environment
- A compatible family of smaller and larger PDP-11 computer systems
- For future market penetration – DIGITAL's worldwide service and support

Cordially,

Michael P. McCarthy
OEM PDP-11/60
Product Marketing Manager

CONTENTS

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                              ┌─────────────────┐
                              │  11/60 TO BE    │
                              │  MOUNTED IN     │
                              └─────────────────┘
                                      │
                                      ▼                    NO. CUSTOM
                                                           CABINETRY
GENERAL              NOT SURE      ╱ DEC ╲                  OR H960
CONFIGURATION  ◄─────────────────╱  CORP  ╲───────────────────────────────►
INFORMATION                      ╲  CAB?  ╱
                                  ╲     ╱
                                      │ YES
                                      ▼                    NO. CORE
                                                           OR OTHER
                                   ╱ WITH 128KB ╲          OPERATING
                                  ╱  MOS MEMORY   ╲        SYSTEM  *
                                  ╲  AND RSX11-M  ╱───────────────────────►
                                   ╲            ╱
                                      │ YES
         YES, FREE-                   ▼              YES, FREE-
         STANDING WITH                              STANDING WITH
         5-FOOT CAB               ╱ RP06 ╲          4-FOOT CAB
SM-60CVB ◄───────────────────────╱  +TE16? ╲──────────────────────────────►
                                  ╲        ╱
                                      │ NO
         YES, FREE                    ▼              YES, FREE-
         STANDING WITH                              STANDING WITH
         5-FOOT CAB               ╱ RM02 ╲          4-FOOT CAB
SM-60UVA ◄───────────────────────╱  +TE16  ╲──────────────────────────────►
                                  ╲        ╱
          YES, FREE-STANDING          │ NO
          WITH 5-FOOT CAB             ▼
SM-60HHB ◄────────────┐                              YES, FREE-
                      │                              STANDING WITH
          YES, TOP-MOUNTED        ╱ RK07'S ╲         4-FOOT CAB
          IN 4-FOOT CAB          ╱          ╲─────────────────────────────►
SM-60LLA ◄────────────┘          ╲          ╱
          YES, TOP                    │ NO
          MOUNTED IN                  ▼              YES, FREE-
          4-FOOT CAB                                STANDING WITH
SM-60HHA ◄───────────────────────╱ RK06'S ╲         EITHER CAB
                                 ╱          ╲─────────────────────────────►
                                  ╲        ╱
          YES, SLIDE-                  │ NO
          MOUNTED IN                  ▼
          5-FOOT CAB              ╱ RL01'S ╲
SM-60KKA ◄───────────────────────╱          ╲
                                  ╲        ╱
                                      │ NO
                                      ▼
                              ┌─────────────────┐
                              │ USE BUILDING    │◄────────────────────────
                              │ BLOCK           │
                              └─────────────────┘
                                      │
            YES                       ▼
11Y60 ◄───────────────────        ╱  5-  ╲
                                 ╱  FOOT   ╲
                                  ╲ CAB?  ╱
                                      │ NO
            YES                       ▼
11X60 ◄───────────────────        ╱  4-  ╲
                                 ╱  FOOT   ╲
                                  ╲ CAB?  ╱
                                      │ NO
11/60                                 ▼
(CABINET- ◄───────────────────────────────────────────────────────────────
LESS)
```

* CERTAIN OTHER PDP-11/60 PACKAGE SYSTEMS ARE
  AVAILABLE BASED ON OTHER OPERATING SYSTEMS;
  PLEASE CONSULT DIGITAL OEM SALES REP.

INTRODUCTION

The chart on page 1 is a guide to the most commonly purchased PDP-11/60 Packaged Systems and PDP-11/60 Building Block Systems.

Packaged Systems combine CPU, memory, operating system, system disk, load device, console terminal, and expansion space into a preconfigured system, all at a total price lower than the sum of the prices of its component parts.

Building Blocks offer greater freedom in mixing and matching configurations to application requirements but do not enjoy the economies of the scale of Packaged Systems.

GENERAL CONFIGURING INFORMATION

PDP-11/60 Systems are packaged in H9600 series corporate cabinets. There are two system cabinet models, differing only in height:

H9600-AA/AB double-width highboy (DWHB), height 1.5 m (5 ft)

H9601-AA/AB double-width lowboy (DWLB), height 1.2 m (4 ft)

They are called "double-width" since each provides two interior 48.3 cm (19 in) wide equipment bays. Both use three-phase power controls and both are available in North American and European power versions.

System expansion may be via these double-width cabinets or via single-width cabinets:

H9602-BA/BB single-width highboy (SWHB), height 1.5 m (5 ft)

H9603-BA/BB single-width lowboy (SWLB), height 1.2 m (4 ft)

These cabinets each provide a single 48.3 cm (19 in) wide equipment bay, use a single-phase power control, and are available in North American and European power versions.

In general the H9600 DWHB cabinet is preferred over the H9601 DWLB as the former provides more vertical mounting space. However, the H9601 is ideal for cab-mounting pairs of top-loading RK07 or RK06 disks and is used in the SM-60HHB and SM-60KKA Packaged Systems and the 11X60 Building Block.

The system cabinet drawing illustrates the H9601; the H9600 differs only in the height of Section C, discussed below.

Section A – This is the CPU card cage. In addition to the CPU backplane there are three system units of mounting space here. Two of them are used for MOS memory when specified. In core memory-based systems, three system units are avilable for options; the core itself is located in the expansion card cage described in Section B.

Section B – This is an expansion card cage. It will hold up to six system units. The memory is located in this card cage on all core memory systems.

Section C – The top of each corporate cabinet has a 48.3 cm (19 in) wide front-to-back mounting space on each side. In the lowboy cabinet this space is 40.0 cm (15.7 in) high; in the highboy cabinet this space is 66.7 cm (26.2 in) high. The rails are standard NEMA configuration and may be used for mounting standard rack-mounted hardware. Note that equipment mounted here is exposed to the front of the cabinet and therefore must contain its own front panel. Standard DIGITAL options that may be mounted here are RX01, RL01, RK06, RK07 (lowboy only), TS03 tape drives, and BA11-K expansion boxes (above the belt-line only). Customer equipment can also be mounted here.

Section D – This is the PDP-11/60 control console with a key lock and octal keyboard and display panel.

Section E – The two power supplies for the logic card cages (one each) mount in this space.

Section F – There is a limited amount of space in the back of the cabinet for mounting 48.3 cm (19 in) panels. The bulk storage cable distribution panel and DZ11 distribution panels mount in this area.

For systems with these options consult the detailed description of available panel mounting space in the Packaged or Building Block System of interest.

Section G – All PDP-11/60 systems contain a three-phase power distribution box. The input power is three-phase either 120/208 Vac (North American) or 240/416 Vac (European). This power distribution box provides single-phase switched and unswitched power receptacles. The equipment in the cabinet is connected to the power distribution box to distribute the load equally over the three phases. The figures on page 32 illustrate the available receptacles on the H866-D distribution box (North American power) and the H866-E (European power).
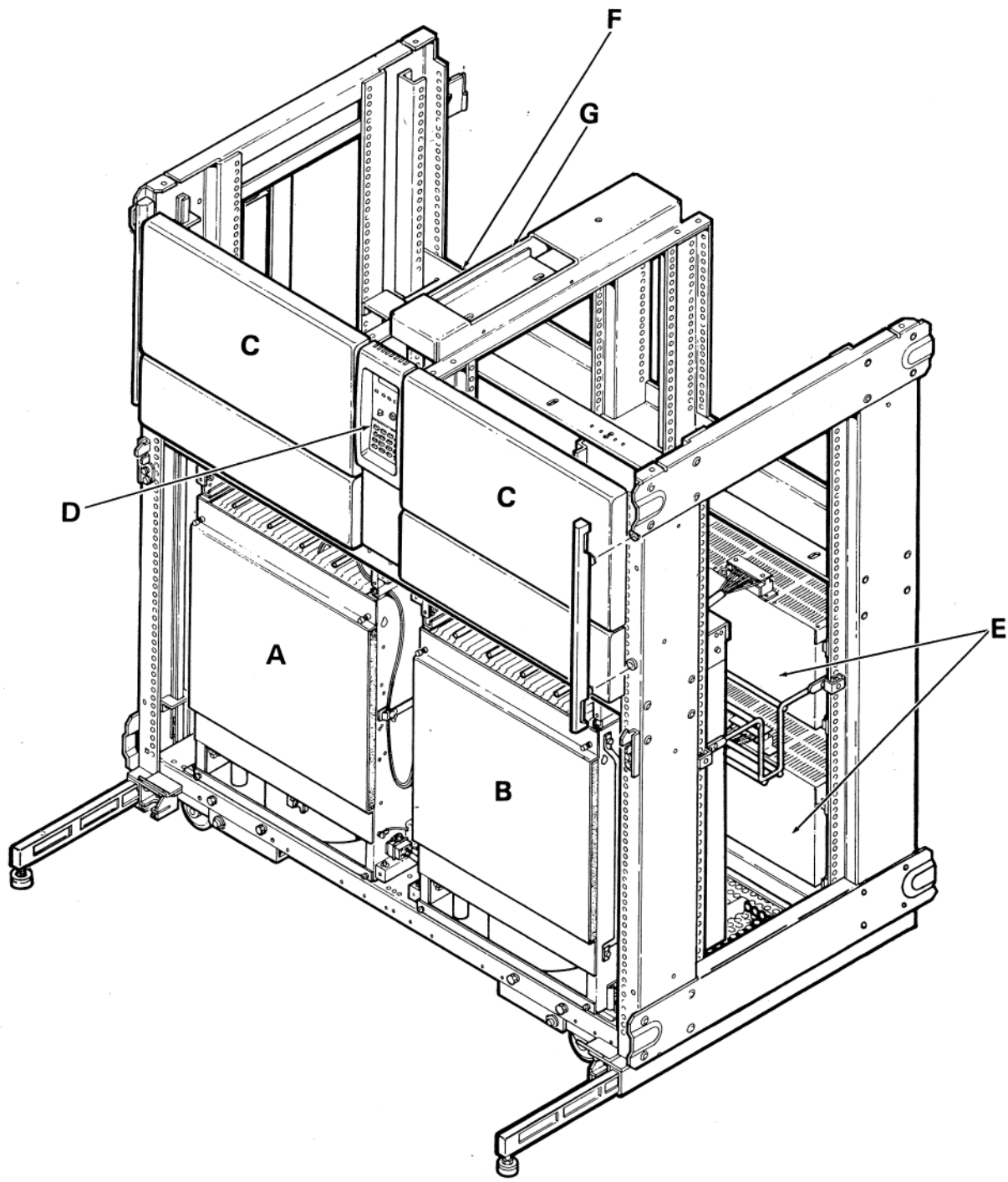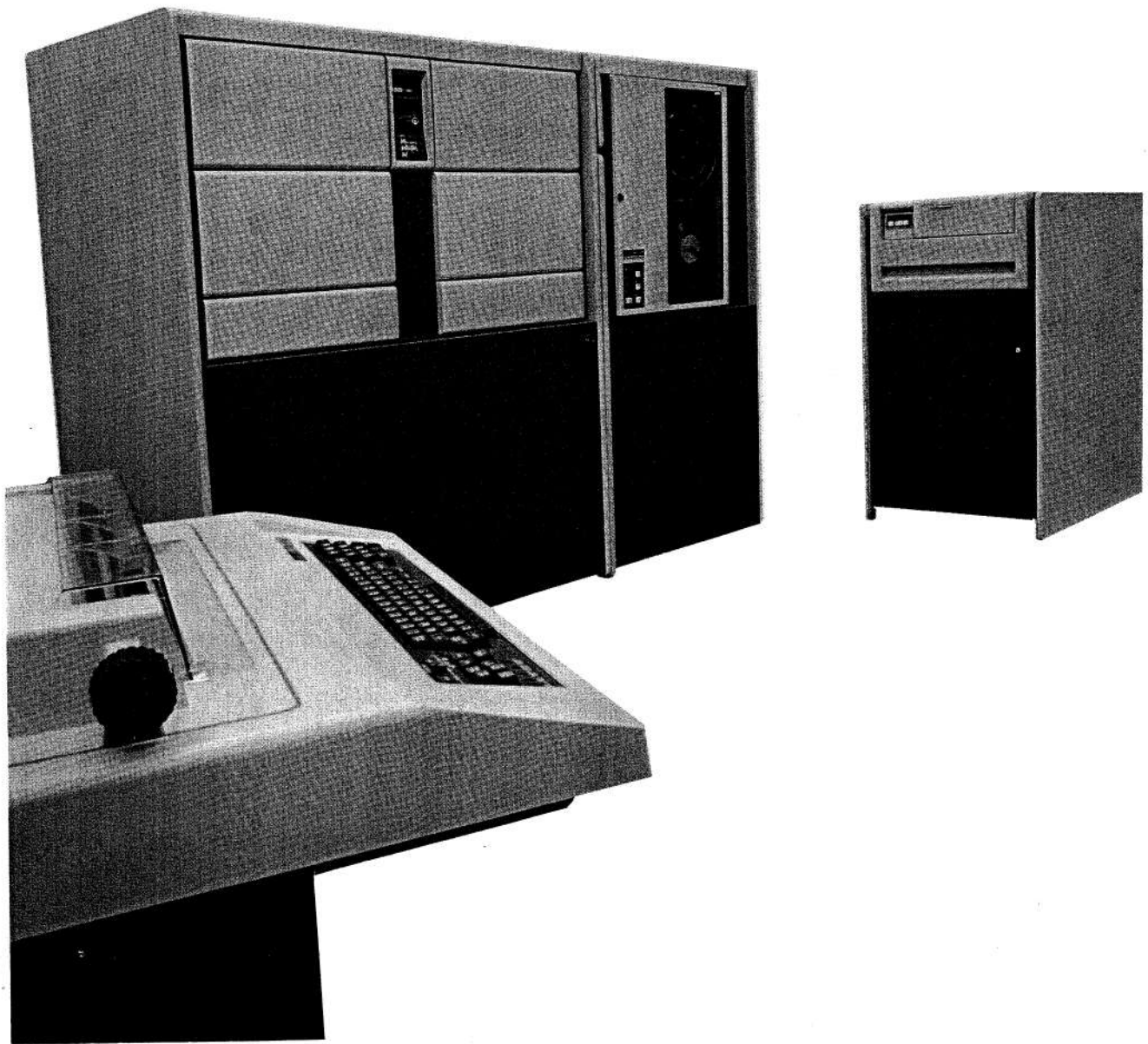
PDP-11/60 System Cabinet
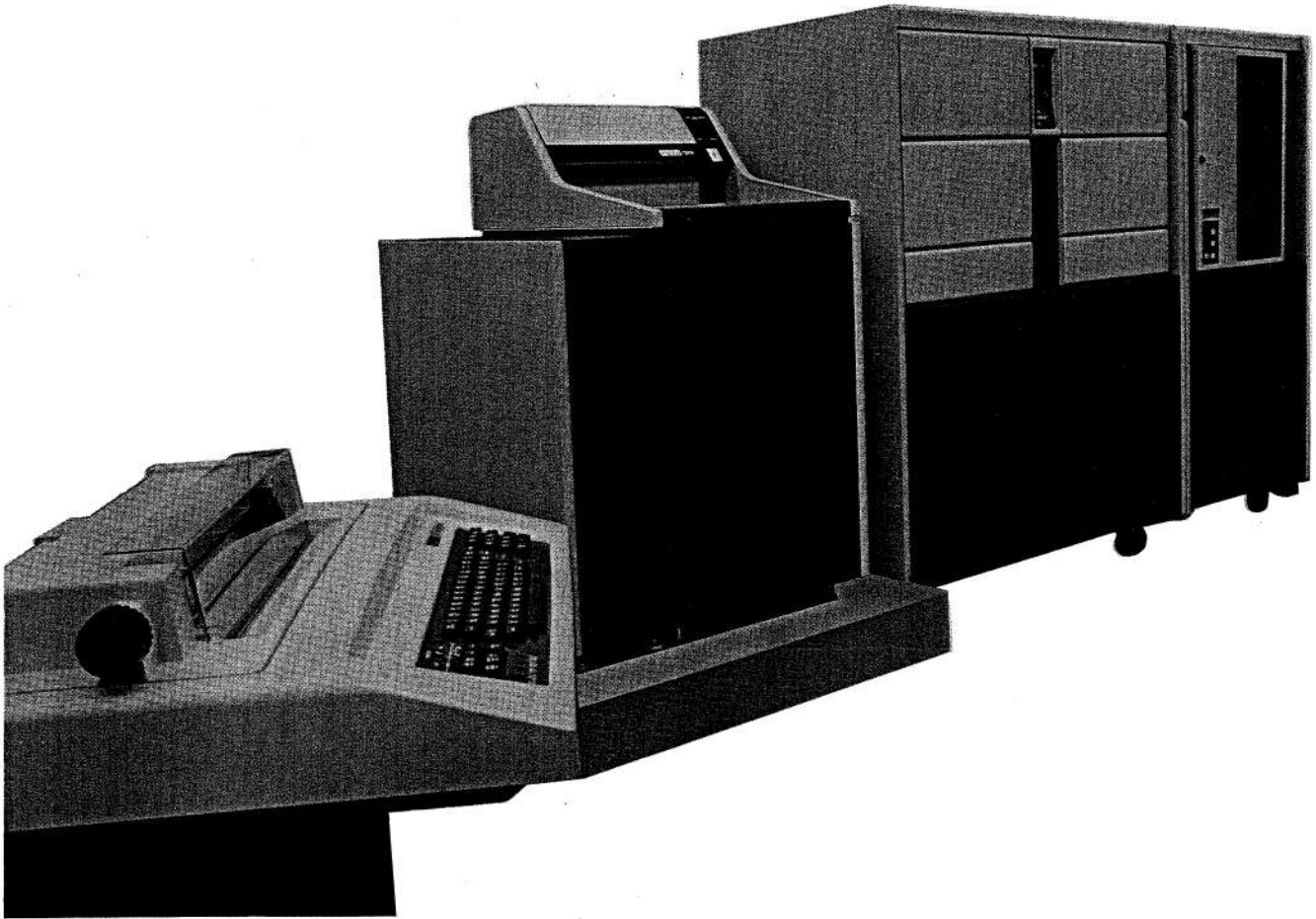
SM-60CVB PACKAGE SYSTEM (See Table 1)

This system includes:

- PDP-11/60 CPU

- RP06 disk drive and controller for 176M bytes of on-line storage

- TE16 magnetic tape drive and controller

- 128K bytes memory (MOS)

- LA36 terminal and controller

- H9600 (double-width highboy) cabinet with three-phase power control

- BA11-PE/PF expansion card cage with power supply

- RSX-11M operating system

Logic Space

The CPU and MOS memory are located in the CPU card cage. The RP06 and TE16 controllers are located in the expansion card cage which is included in this configuration. The logic space is defined below. Shaded areas are available for general expansion.

Cabinet Space

The RP06 and TE16 drives do not mount in the CPU cabinet but are stand-alone peripherals. The space above the belt line, 66.7 cm (26.2 in) on each side, is available for DIGITAL or customer options. The disk/magtape cable distribution panel is mounted in the rear.

Two communication distribution panels can be mounted in the rear if the system does not include an FP11-E option; otherwise there is room for only one.

The system may be expanded with single-width highboy or double-width highboy expansion cabinets. See the section on Expansion Cabinets for further information.

CPU BA11-P

NOTE:

Shaded areas indicate available space .

EXPANSION BA11-P

SM-60CVB Logic Space

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SM-60UVA PACKAGE SYSTEM (See Table 1)

This system includes:

- PDP-11/60 CPU

- RM02 disk drive and controller for 67M bytes of on-line storage

- TE16 magnetic tape drive and controller

- 128K bytes memory (MOS)

- LA36 terminal and controller

- H9600 (double-width highboy) cabinet with three-phase power control

- BA11-PE/PF expansion card cage with power supply

- RSX-11M operating system

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Logic Space

The CPU and MOS memory are located in the CPU card cage. The RM02 and TE16 controllers are located in the expansion card cage. The logic space is defined below. Shaded areas are available for general expansion.

Cabinet Space

The RM02 and TE16 drives do not mount in the CPU cabinet but are stand-alone peripherals. The space above the belt line, 66.7 cm (26.2 in) on each side, is available for DIGITAL or customer options. The disk/magtape cable distribution panel is mounted in the rear.

Two communication distribution panels can be mounted in the rear if the system does not include an FP11-E option; otherwise there is room for only one.

The system may be expanded with single-width highboy or double-width highboy expansion cabinets. See the section on Expansion Cabinets for further information.
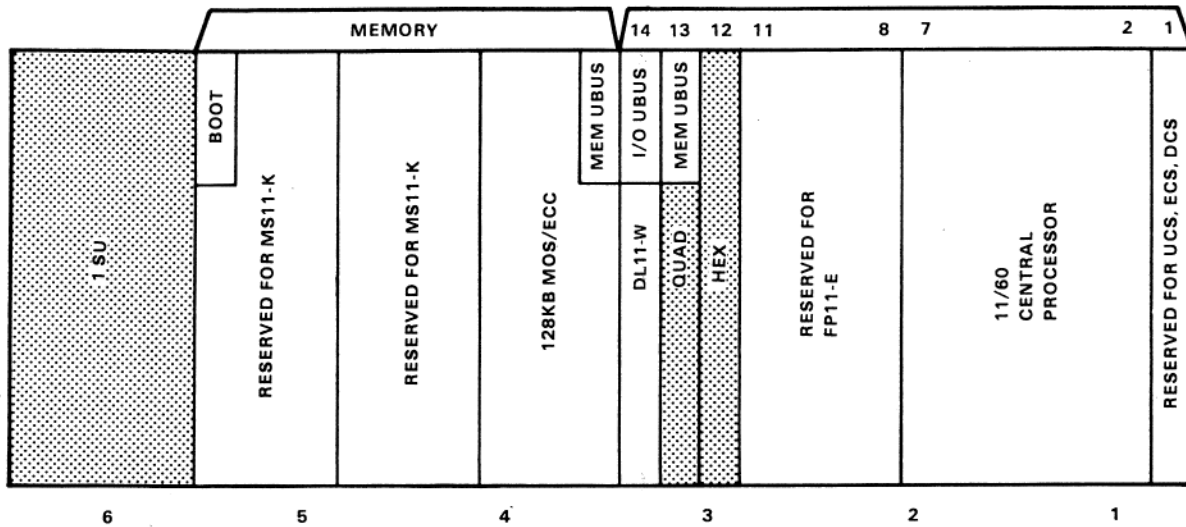
CPU BA11-P

NOTE:
Shaded areas indicate available space .
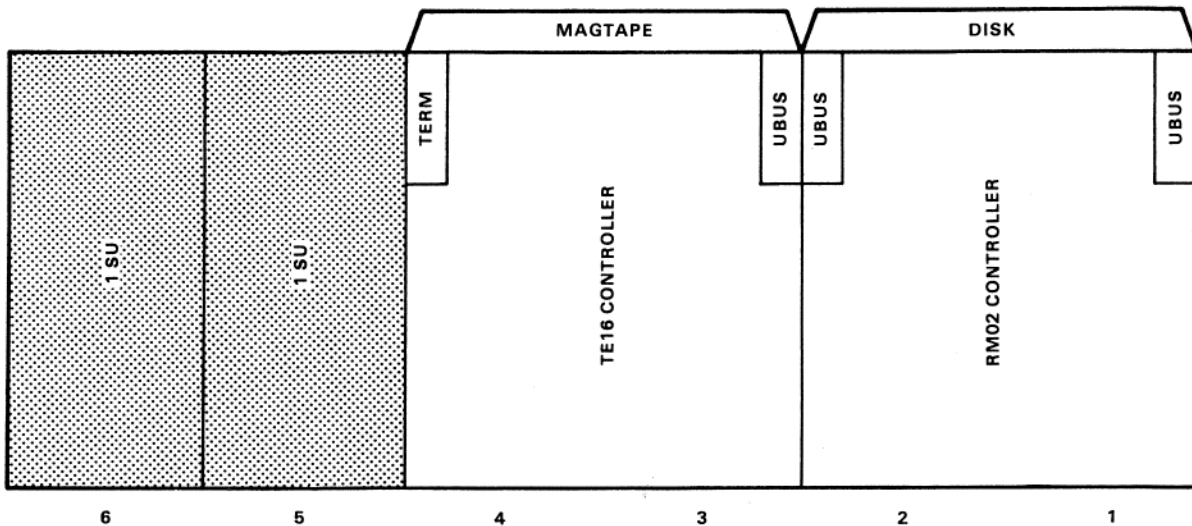
EXPANSION BA11-P

SM-60UVA Logic Space

7
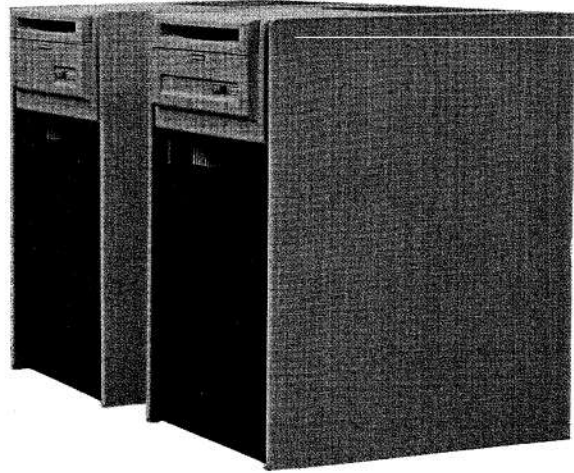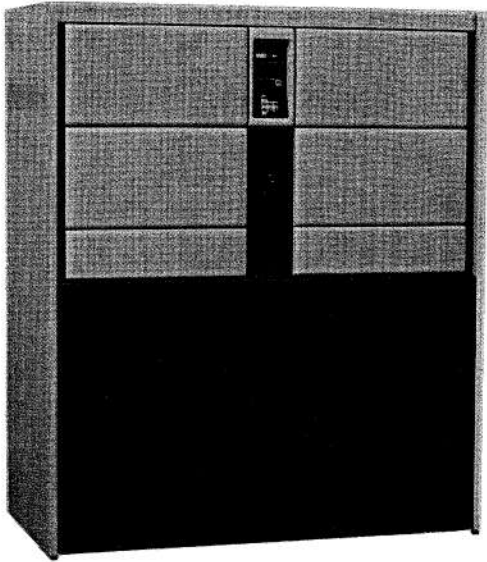
SM-60HHA PACKAGE SYSTEM (See Table 1)

This system includes:

- PDP-11/60 CPU

- Two (free-standing) RK07 disk drives and controller for 56M bytes of on-line storage

- 128K bytes of memory (MOS)

- LA36 terminal and controller

- H9600 (dual-width highboy) cabinet

- BA11-PE/PF expansion card cage
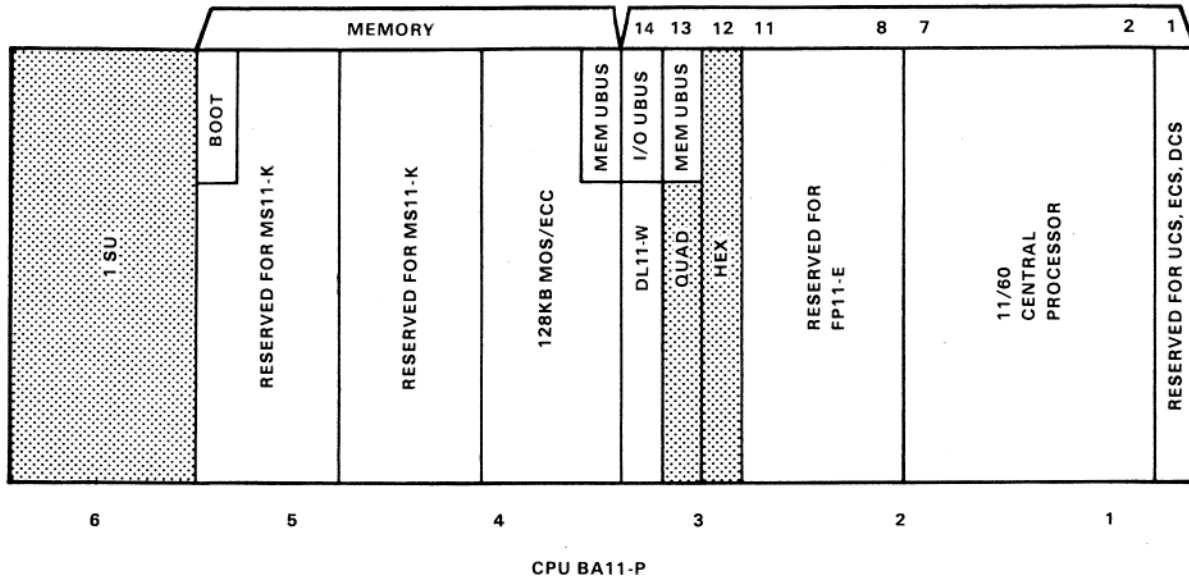
- RSX-11/M operating system

Logic Space

The CPU and MOS memory are located in the CPU card cage. The RK711 disk controller is mounted in the expansion card cage. The logic space is defined below.

Cabinet Space

The two RK07 disks are free-standing in this configuration and do not mount in the CPU cabinet. The space above the belt line, 66.7 cm (26.2 in) on each side, is available for DIGITAL or customer options. Two communication distribution panels can be mounted in the rear if the system does not include an FP11-E option; otherwise there is room for only one. For further information on the cabinet, refer to the 11Y60 description.

The system may be expanded with single-width highboy or double-width highboy expansion cabinets. See the section on Expansion Cabinets for further information.

CPU BA11-P

NOTE:
Shaded areas indicate available space.

EXPANSION BA11-P
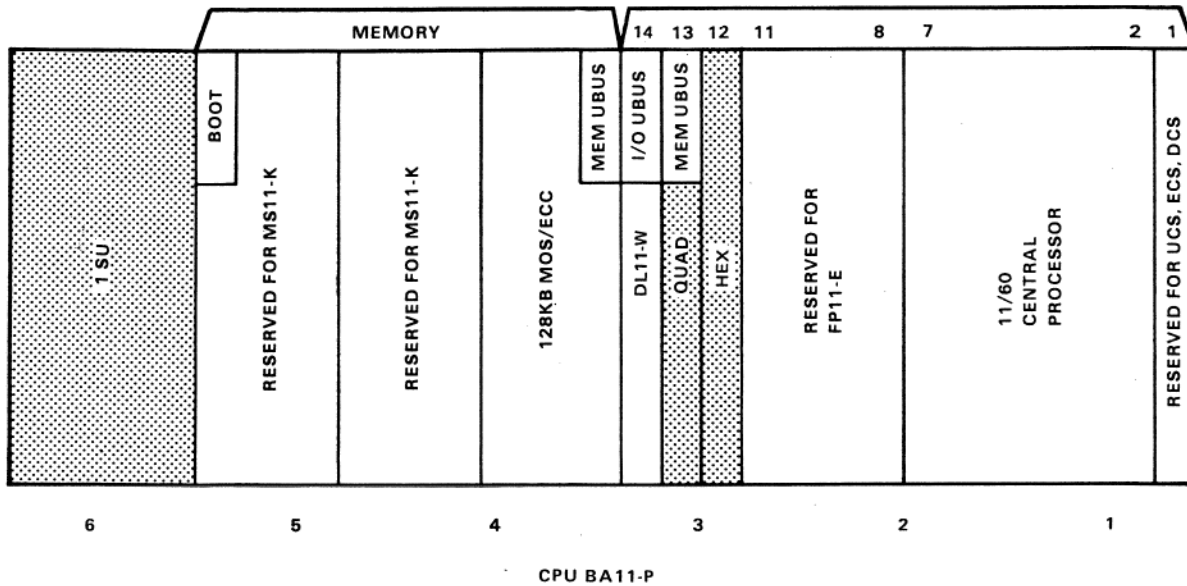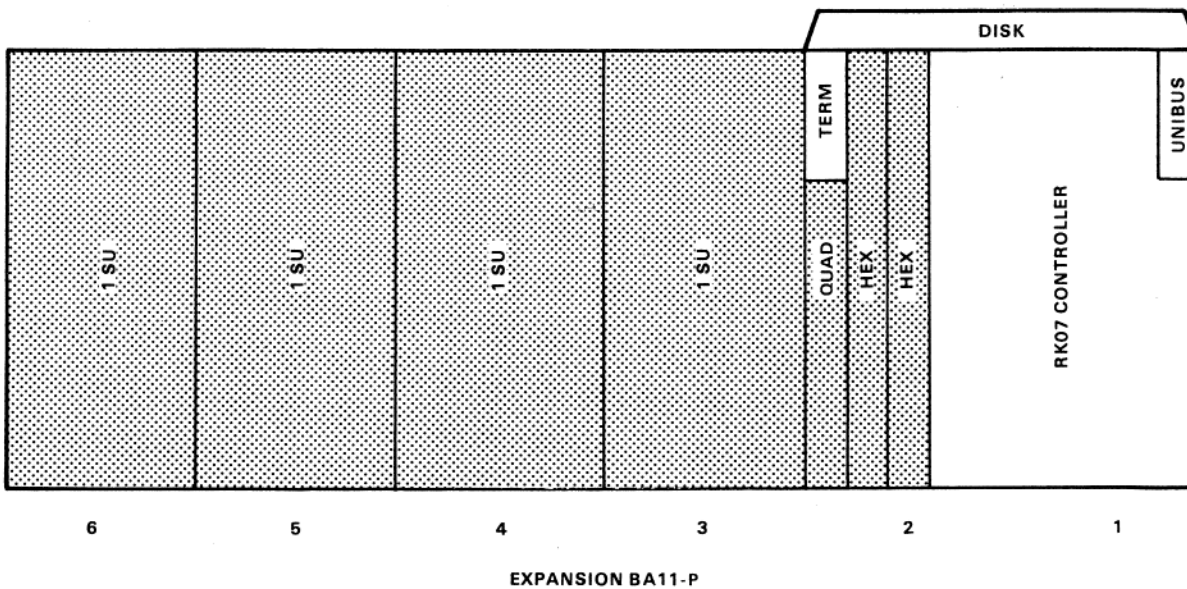
SM-60HHA Logic Space

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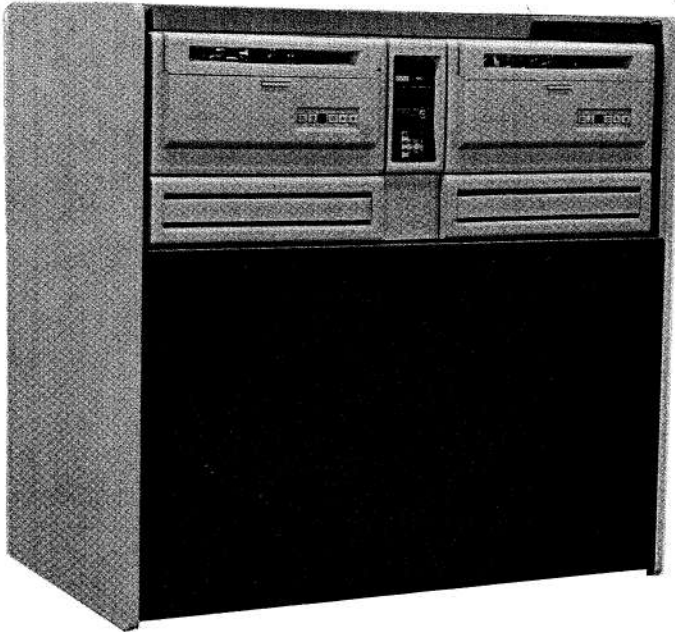
SM-60HHB PACKAGE SYSTEM (See Table 1)

This system includes:

- PDP-11/60 CPU

- Two RK07 disk drives and controller for 56M bytes of on-line storage mounted in system cabinet

- 128K bytes of memory (MOS)

- LA36 terminal and controller

- H9601 (double-width lowboy) cabinet

- BA11-PE/PF expansion card cage
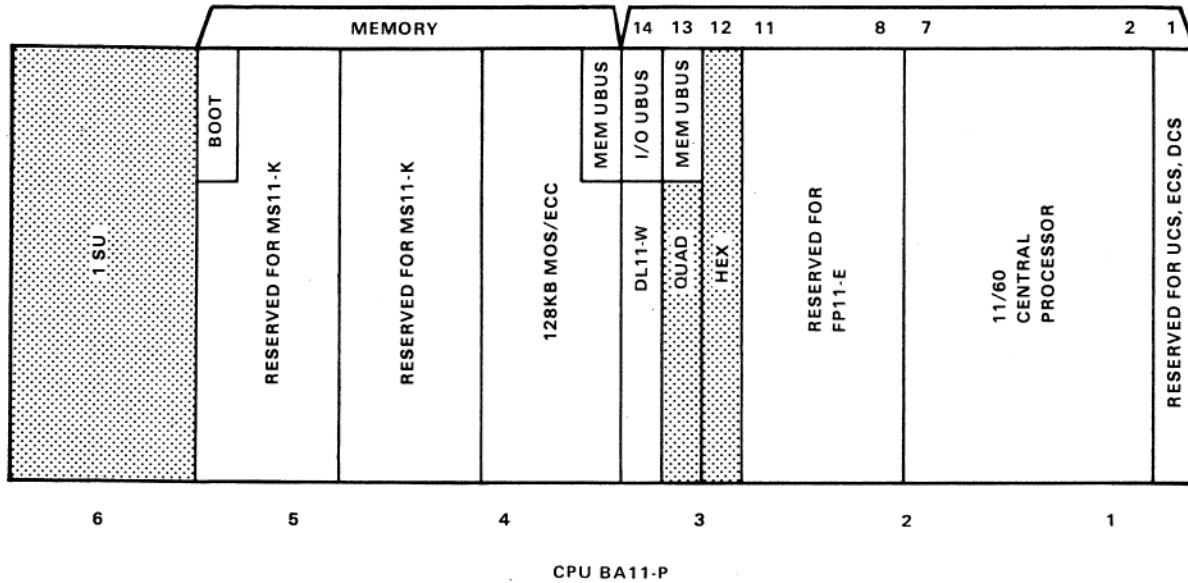
- RSX-11/M operating system

Logic Space

The CPU and MOS memory are located in the CPU card cage. The RK711 disk controller is mounted in the expansion card cage. The logic space is defined below.

Cabinet Space

The 60HHB System makes very effective use of the space available in the DWLB cabinet. The two RK07 disk drives occupy all the space above the belt line. The controller mounts in the expansion card cage. The only space remaining is panel space in the back. Two communication distribution panels can be mounted in this space if the system does not include an FP11-E option; otherwise there is room for only one.

The system may be expanded with single-width highboy or double-width highboy expansion cabinets. See the section on Expansion Cabinets for further information.

CPU BA11-P

NOTE:

Shaded areas indicate available space.

EXPANSION BA11-P

SM-60HHB Logic Space

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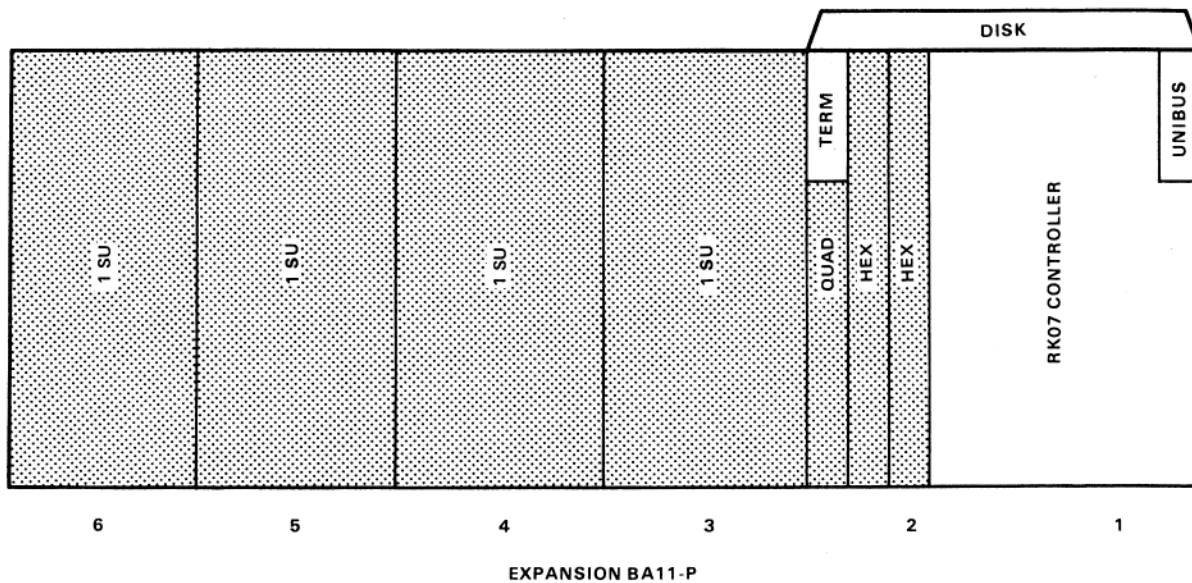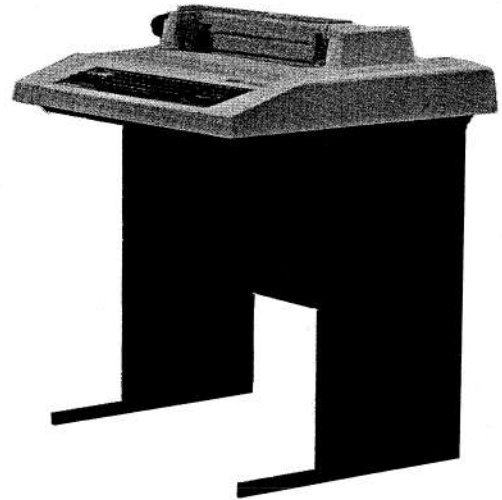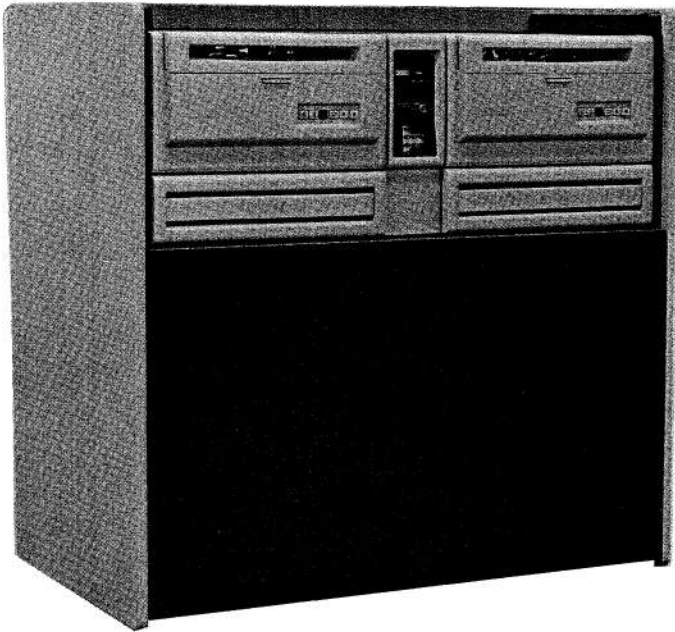
SM-60KKA PACKAGE SYSTEM (See Table 1)

This system includes:

- PDP-11/60 CPU

- Two RK06 disk drives and controller for 28M bytes of on-line storage mounted in system cabinet

- 128K bytes of memory (MOS)

- LA36 terminal and controller

- H9601 (dual-width lowboy) cabinet

- BA11-PE/PF expansion card cage

- RSX-11/M operating system

Logic Space

The CPU and MOS memory are located in the CPU card cage. The RK711 disk controller is mounted in the expansion card cage. The logic space is defined below.

Cabinet Space

The SM-60KKA System makes very effective use of the space available in the DWLB cabinet. The two RK06 disk drives occupy all the space above the belt line. The controller requires the addition of the expansion card cage. The only space remaining is panel space in the back. Two communication distribution panels can be mounted in this space if the system does not include an FP11-E option; otherwise there is room for only one.

The system may be expanded with single-width highboy or double-width highboy expansion cabinets. See the section on Expansion Cabinets for further information.

CPU BA11-P

NOTE:
Shaded areas indicate available space.

EXPANSION BA11-P

SM-60KKA Logic Space
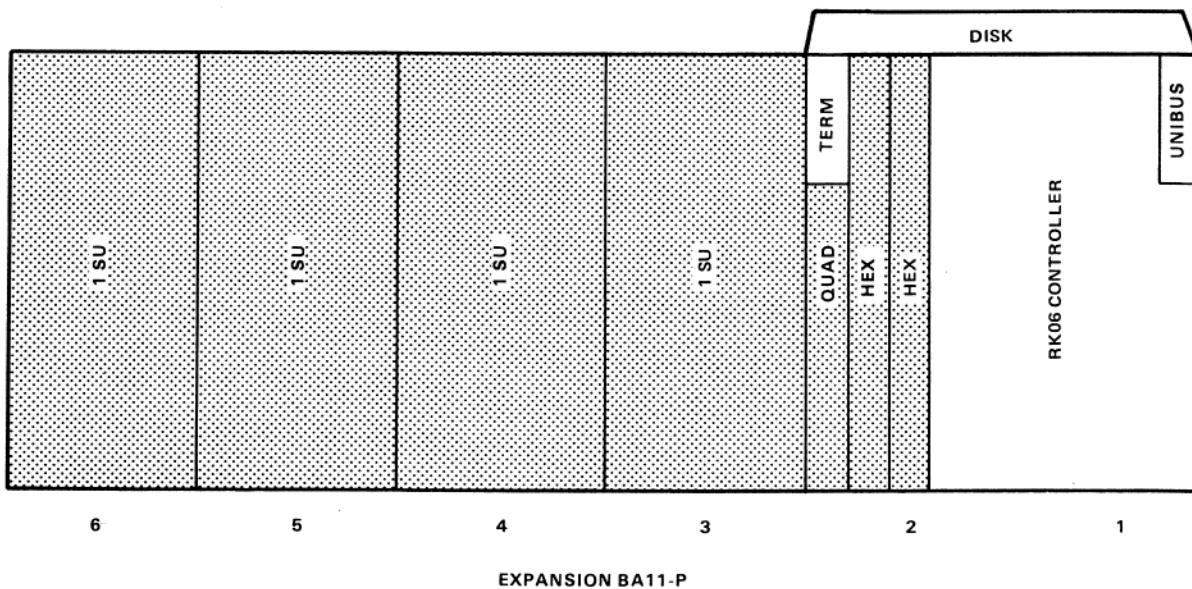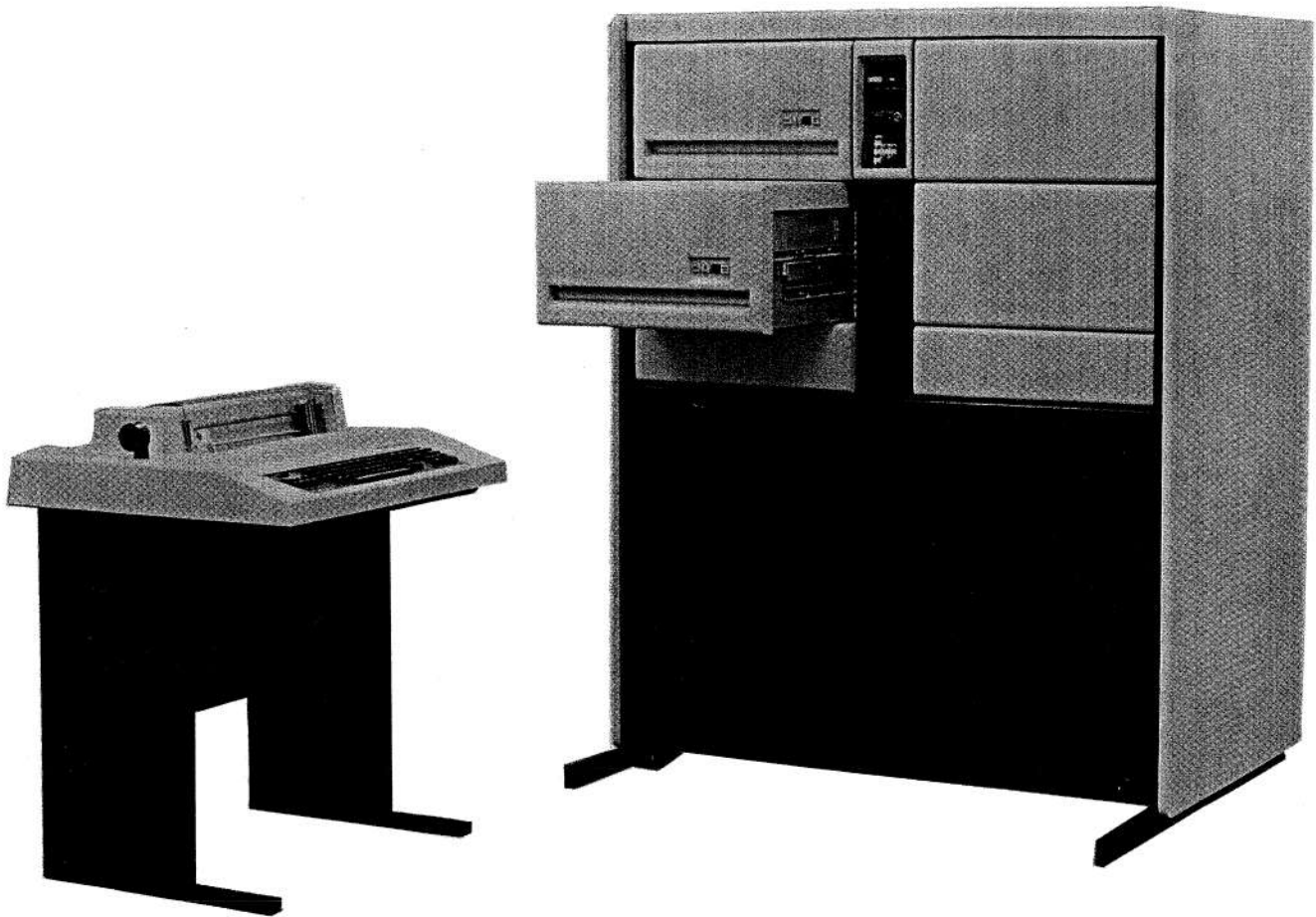
SM-60LLA PACKAGE SYSTEM (See Table 1)

This system includes:

- PDP-11/60 CPU

- Two RL01 disk drives and controller for 10.4M bytes of on-line storage mounted in system cabinet

- 128K bytes of memory (MOS)

- LA36 terminal and controller

- H9600 (double-width highboy) cabinet

- BA11-PE/PF expansion card cage

- RSX-11/M operating system

Logic Space
The CPU, MOS memory, and RL11 disk controller are all located within the CPU card cage. The expansion card cage provides additional mounting space. The logic space is defined below.

Cabinet Space
The RL01 disks are normally mounted in the upper left side of the cabinet. There are 13.0 cm (5.2 in) of free space between the lower disk and the cabinet center brace. Only the H322 lab peripheral distribution panel can be mounted here.
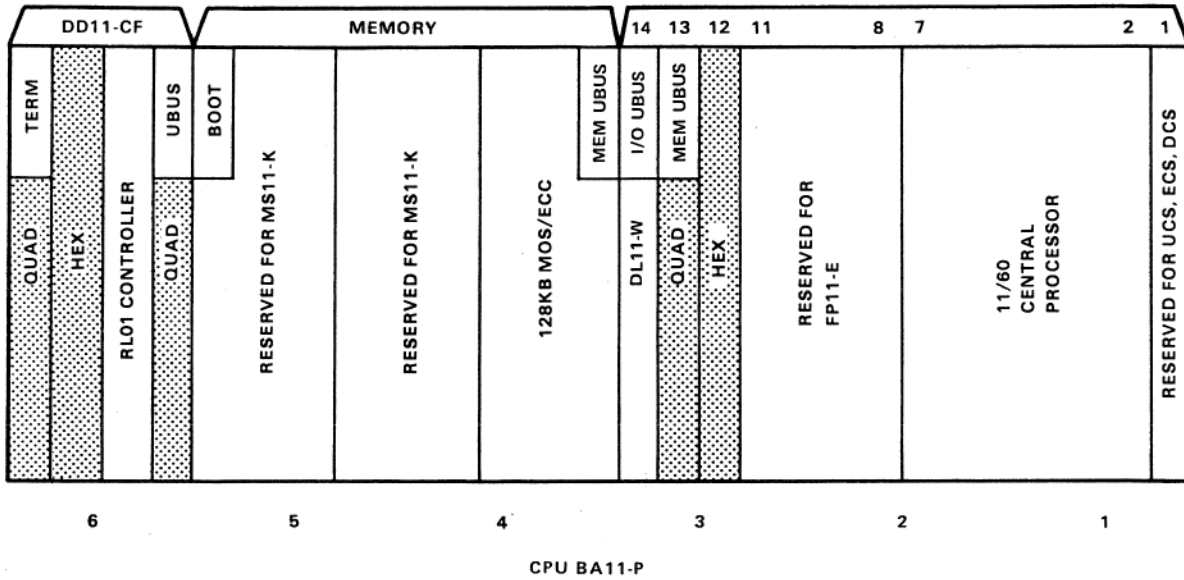
The upper right side of the cabinet has 66.7 cm (26.2 in) of vertical mounting space. This space is covered by two 26.7 cm (10.5 in) panels and one 13.3 cm (5.2 in) panel. When an option is mounted in this area, the panels are removed and the option is visible from the front. Only options with front panels such as RL01 disks, TS03 magnetic tapes, logic drawers, or customer equipment with face plates can mount here. Logic panels such as DH11-A distribution panels or DT03 Unibus switches cannot be mounted here because they would leave the wired backplane exposed.

In the back of the cabinet on the lower right side, above the power controller, is space for mounting of H317-type distribution panels. This space is also used for the FP11-E power supply and the MOS memory battery backup unit. A system with FP11-E has room for *one* H317 communications distribution panel here; other systems have room for two distribution panels.

Distribution panels may also be mounted above the belt line in the rear of the cabinet if there is no peripheral mounted on the front. Most peripherals, such as RL01 disks, extend from the front to the back

of the cabinet and leave no room for distribution panels. There is not enough room behind the 13.3 cm (5.2 in) blank panel below the two RL01 disks for an H317 communications distribution panel; H317s can be mounted behind the blank panels on the right side of the cabinet.
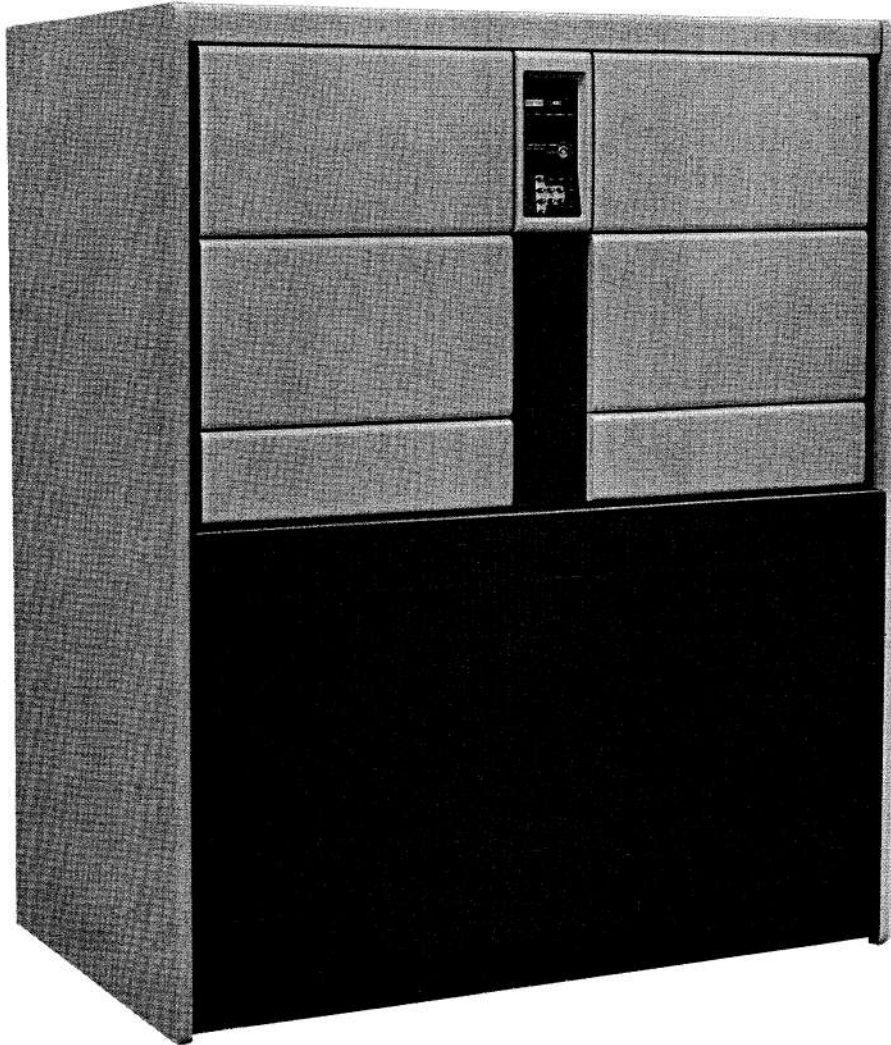
The system may be expanded with single-width highboy or double-width highboy expansion cabinets. See the section on Expansion Cabinets for further information.

CPU BA11-P

NOTE:
Shaded areas indicate available space .

EXPANSION BA11-P
STANDARD

SM-60LLA Logic Space

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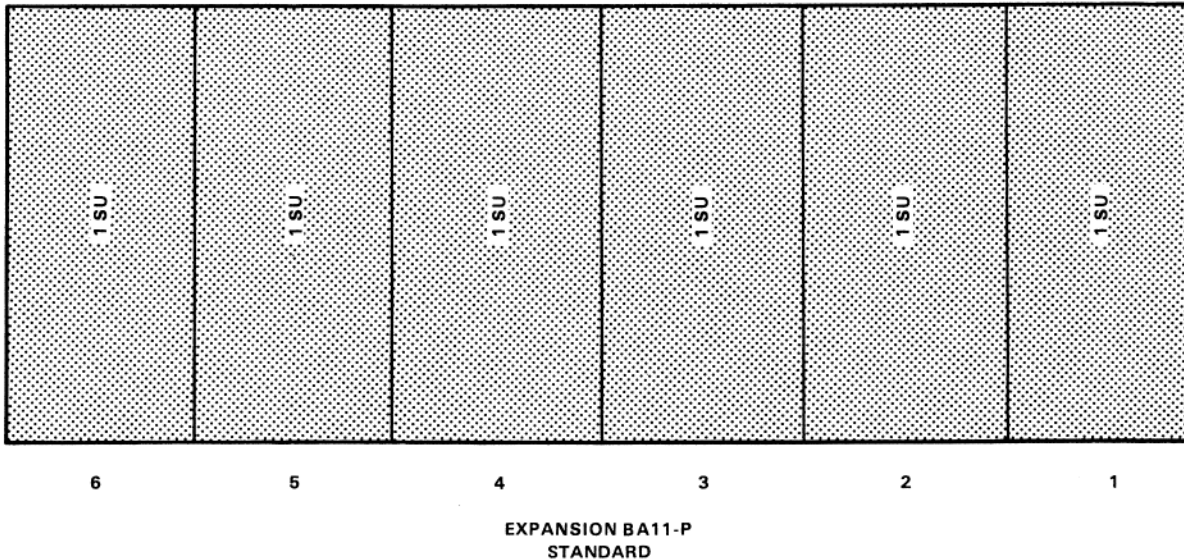
**11Y60-CA/CB (MOS) BUILDING BLOCK SYSTEM
-BA/BB (Core) (See Table 1)**

This system includes:

- PDP-11/60 CPU

- 64K bytes of memory

- BA11-PE/PF expansion card cage (core model only)

- DL11-W terminal controller

- H9600 (double-width highboy) cabinet

Logic Space

MOS memory configurations (11Y60-CA/CB) are contained in one BA11-P card cage.
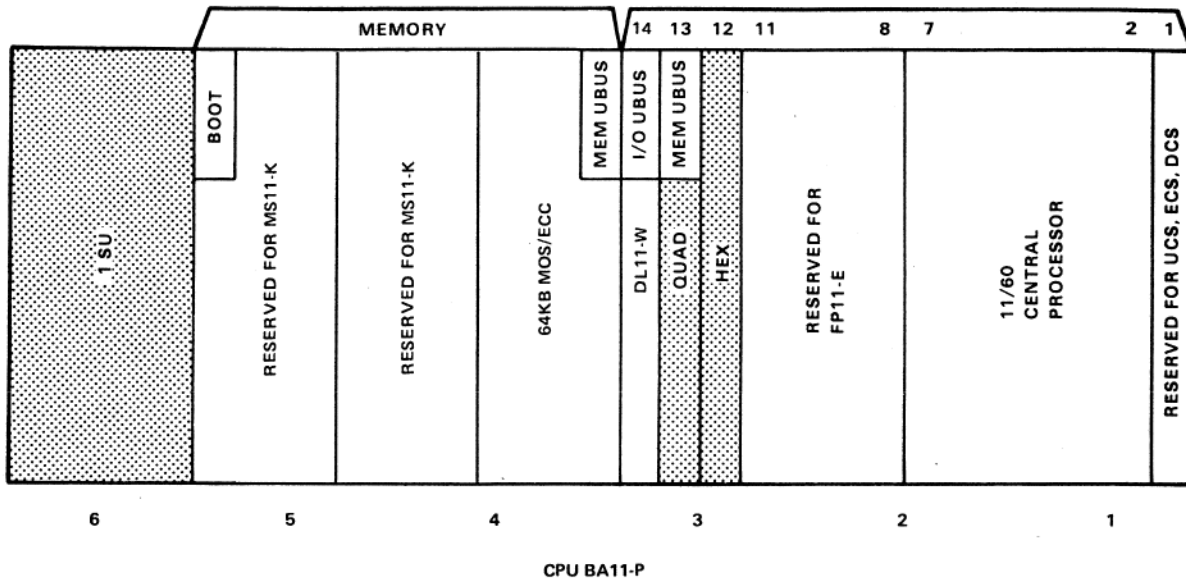The cage is arranged as shown below.

Core memory configurations (11Y60-BA/BB) are contained in two BA11-P card cages with all the core memory located in the expansion card cage. The cages are arranged as shown on page 18.

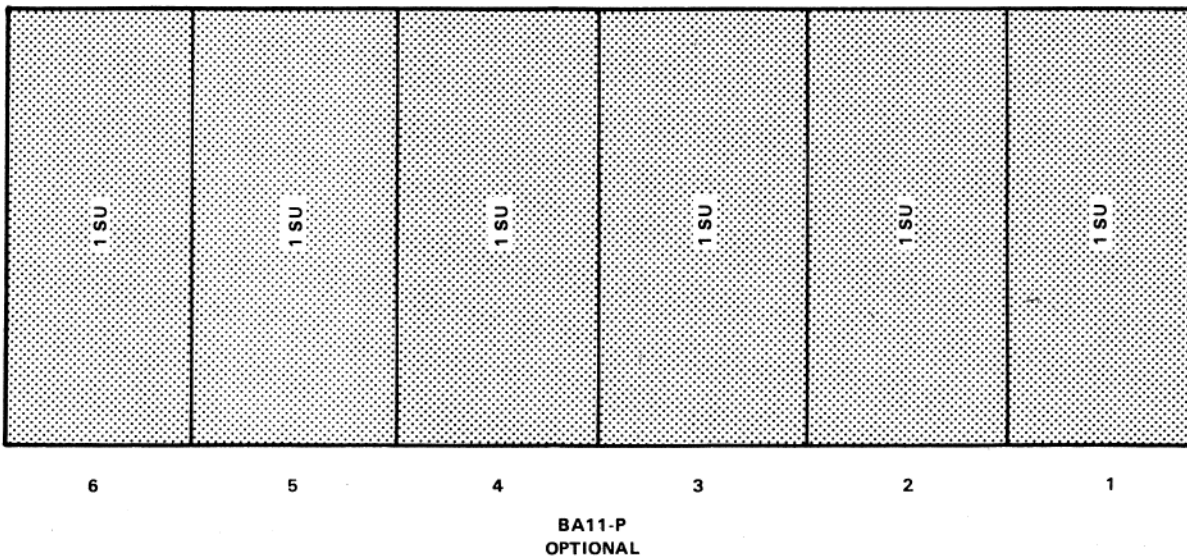## Cabinet Space

Both the upper left and upper right portions of the 11Y60 cabinet provide 66.7 cm (26.2 in) of vertical

mounting space. These spaces are covered with two 26.7 cm (10.5 in) panels and one 13.3 cm (5.2 in) panel.

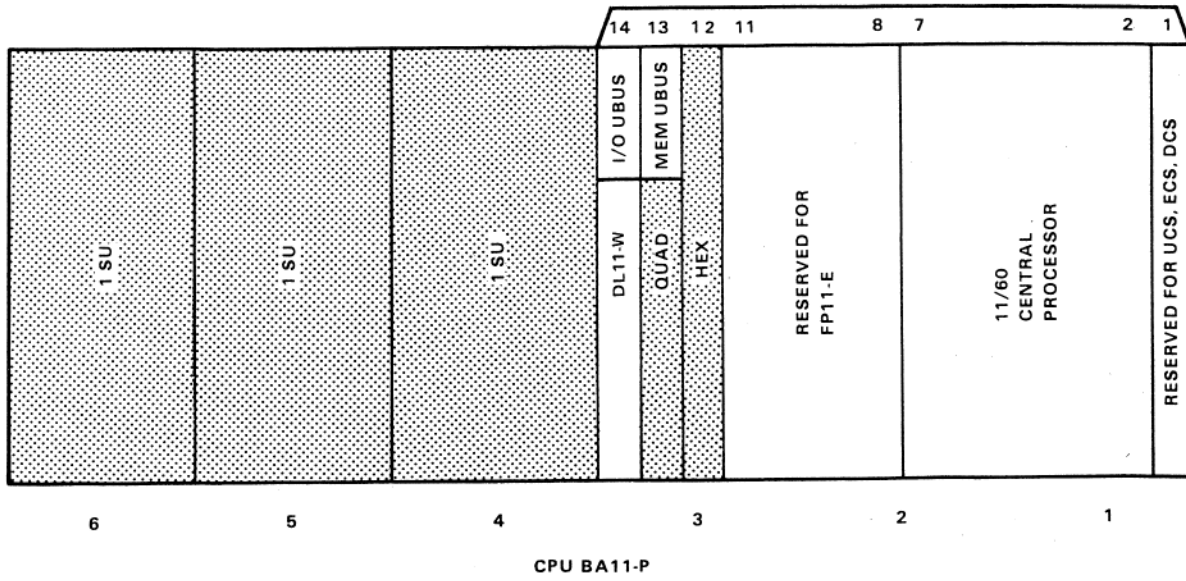There are restrictions on the use of this space. (See the 11X60 description.

The space below the belt line of the 11Y60 is identical to that of the 11X60.

CPU BA11-P

NOTE:
Shaded areas indicate available space.

BA11-P
OPTIONAL

11Y60-CA/CB MOS, DWHB

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CPU BA11-P

Diagram labels (top row, right section): 14 13 12 11 8 7 2 1

Slot labels: I/O UBUS, MEM UBUS, DL11-W, QUAD, HEX, RESERVED FOR FP11-E, 11/60 CENTRAL PROCESSOR, RESERVED FOR UCS, ECS, DCS

1 SU, 1 SU, 1 SU

Bottom numbers: 6 5 4 3 2 1

NOTE:
Shaded areas indicate available space.

MEMORY

BOOT, 64KB CORE MEMORY, OPTIONAL: MM11-WP ADDITIONAL 64KB CORE, MEM UBUS

1 SU, 1 SU, 1 SU, 1 SU

Bottom numbers: 6 5 4 3 2 1

BA11-P STANDARD
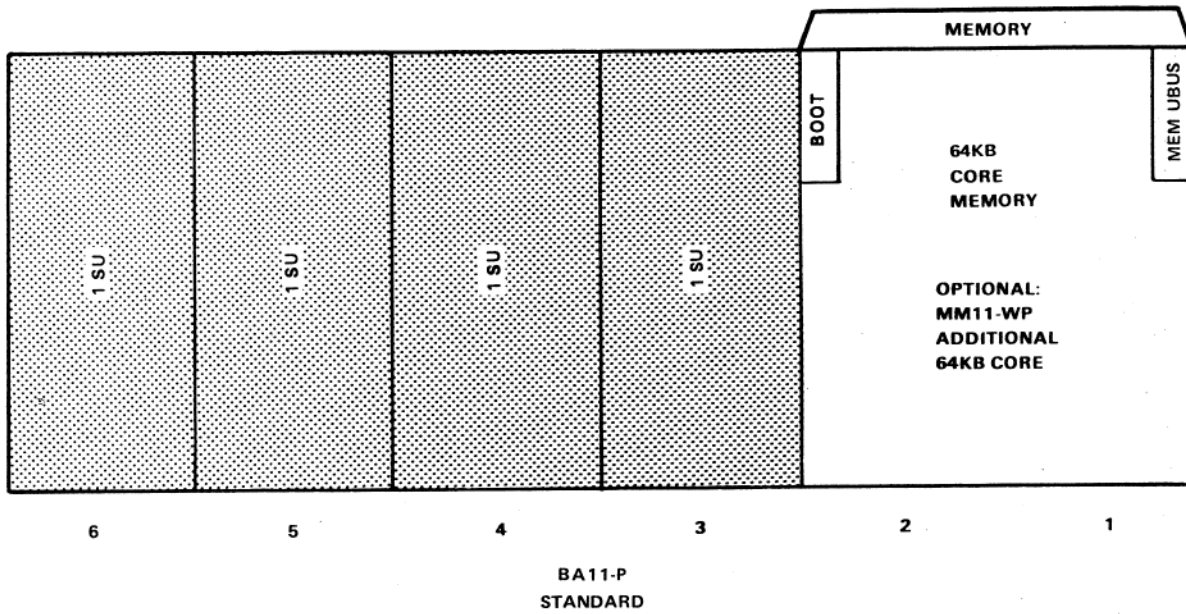
11Y60-BA/BB Core, DWHB

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NOTES:
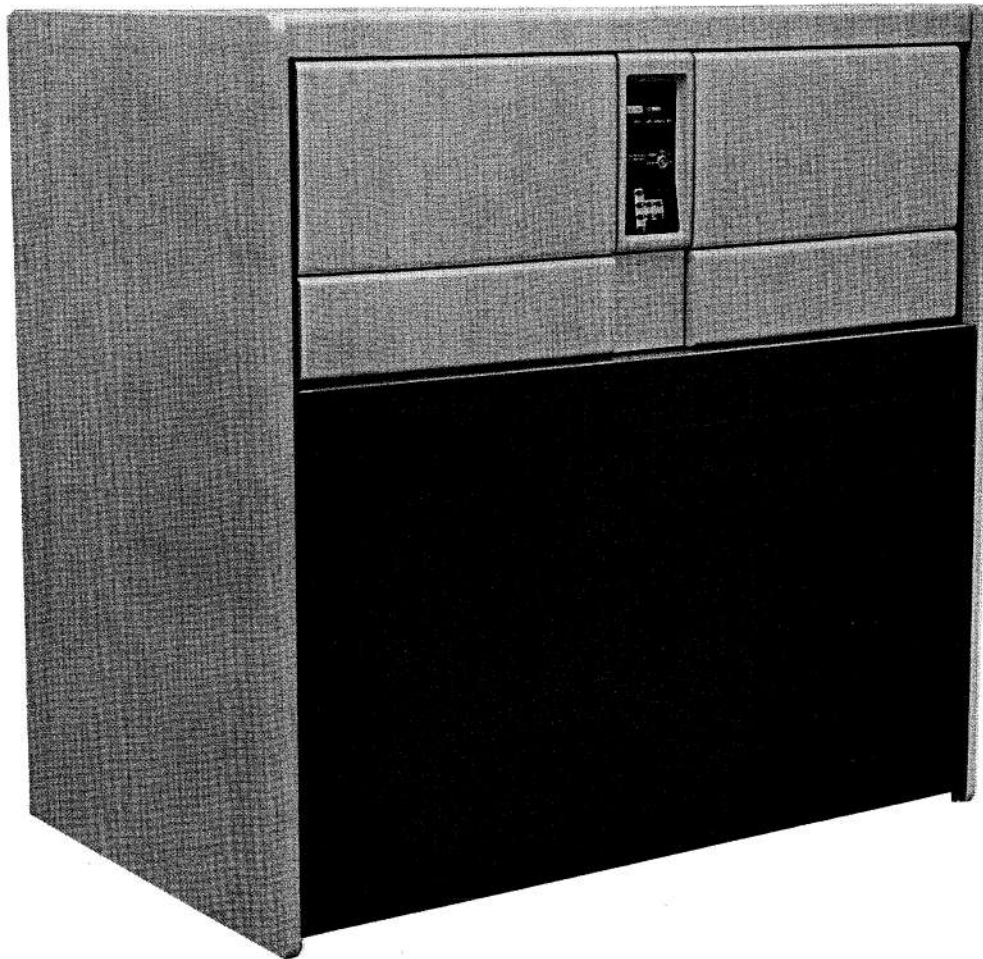
11X60-CA/CB (MOS) BUILDING BLOCK SYSTEM
-BA/BB (Core) (See Table 1)

This system includes:

- PDP-11/60 CPU

- 64K bytes of memory

- BA11-PE/PF expansion card cage (core model only)

- DL11-W terminal controller

- H9601 (double-width lowboy) cabinet

Logic Space
MOS memory configurations (11X60-CA/CB) are contained in one BA11-P card cage.

The cage is arranged as shown on page 21.

Core memory configurations (11X60-BA/BB) are contained in two BA11-P card cages with all the core memory located in the expansion card cage. The cages are arranged as shown on page 22.

Cabinet Space
Both the upper left and upper right portions of the 11X60 cabinet provide 40.0 cm (15.7 in) of vertical mounting space. These spaces each are covered with one 26.7 cm (10.5 in) panel and one 13.3 cm (5.2 in) panel.

When an option is front-mounted in any of these spaces, the trim panels must be removed, leaving the option exposed. Consequently, only options having their own front panels or face plates should be installed here (e.g., RL01 disk, TS03 magnetic tape).

Logic panels such as the DT03 Unibus switch should not be mounted on the front here because their wired backplanes would be exposed. For installation of the DT03 in PDP-11/60 systems, consult the CSS group.

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Other rail-mounted logic panels may be mounted below the belt line (behind the removable front cover) of a system or expansion cabinet.

In the back of the cabinet on the lower right side, above the power control, there is space for mounting distribution panels. This space is also used for the FP11-EA/EB power supply and the MOS memory battery backup unit. A system with *both* MOS and FP11-EA/EB has room for *one* distribution panel; all other systems can mount *two* distribution panels here.

Distribution panels may also be mounted above the belt line in the rear of a system or expansion cabinet provided no option has been front-mounted at that level (option depth usually precludes this) and provided at least 19.1 cm (7.5 in) of vertical space are available (room for small panel plus room for cable clearance).

In the core version of both the 11X60 and 11Y60, all the memory is mounted in an expansion BA11-PE/PF provided with the system as standard. This space is empty in the MOS version of both the 11X60 and 11Y60 and may be used to mount a BA11-PE/PF.
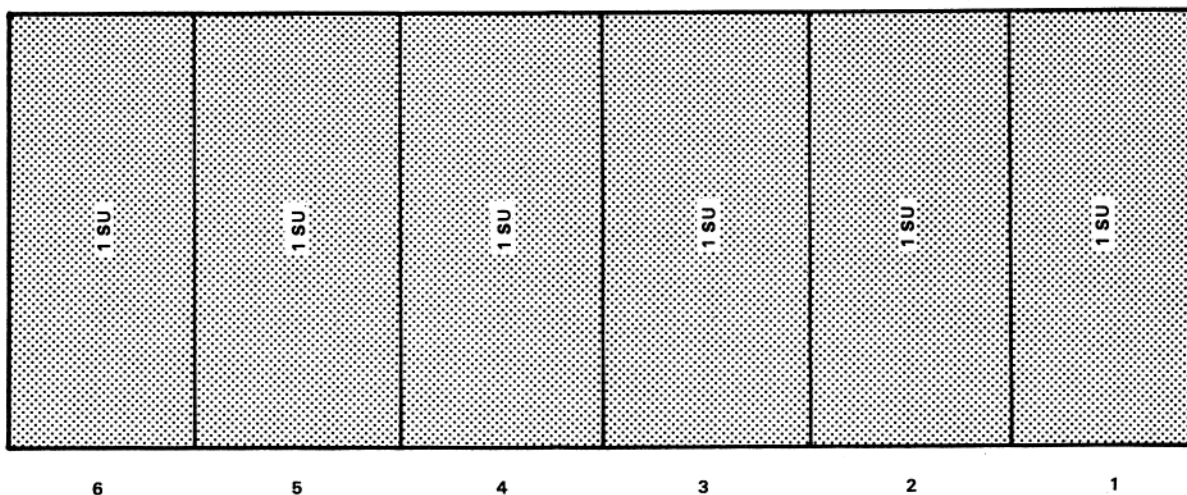
The system may be expanded with single-width highboy or double-width highboy expansion cabinets. See the section on Expansion Cabinets for further information.
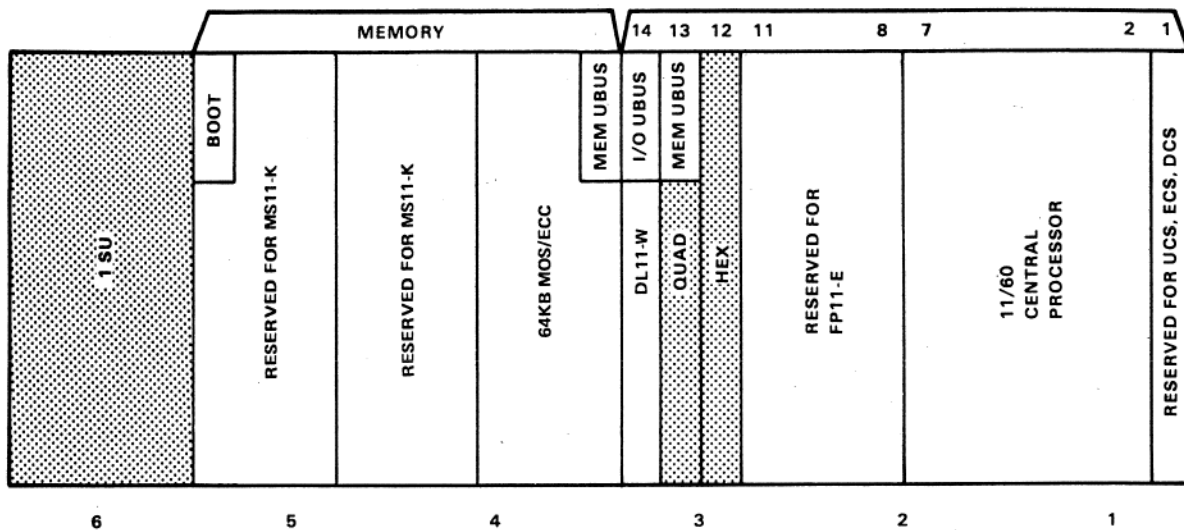
CPU BA11-P

NOTE:
   Shaded areas indicate available space.

BA11-P
(OPTIONAL)

11X60-CA/CB MOS, DWLB

CPU BA11-P

6	5	4	3				2	1
1 SU	1 SU	1 SU	DL11-W / I/O UBUS	QUAD / MEM UBUS	HEX	RESERVED FOR FP11-E	11/60 CENTRAL PROCESSOR	RESERVED FOR UCS, ECS, DCS

Slot numbers (top): 14 13 12 11 8 7 2 1

CPU BA11-P

NOTE:
Shaded areas indicate available space .

MEMORY

6	5	4	3	2	1
1 SU	1 SU	1 SU	1 SU	BOOT 64KB CORE MEMORY OPTIONAL: MM11-WP ADDITIONAL 64KB CORE	MEM UBUS
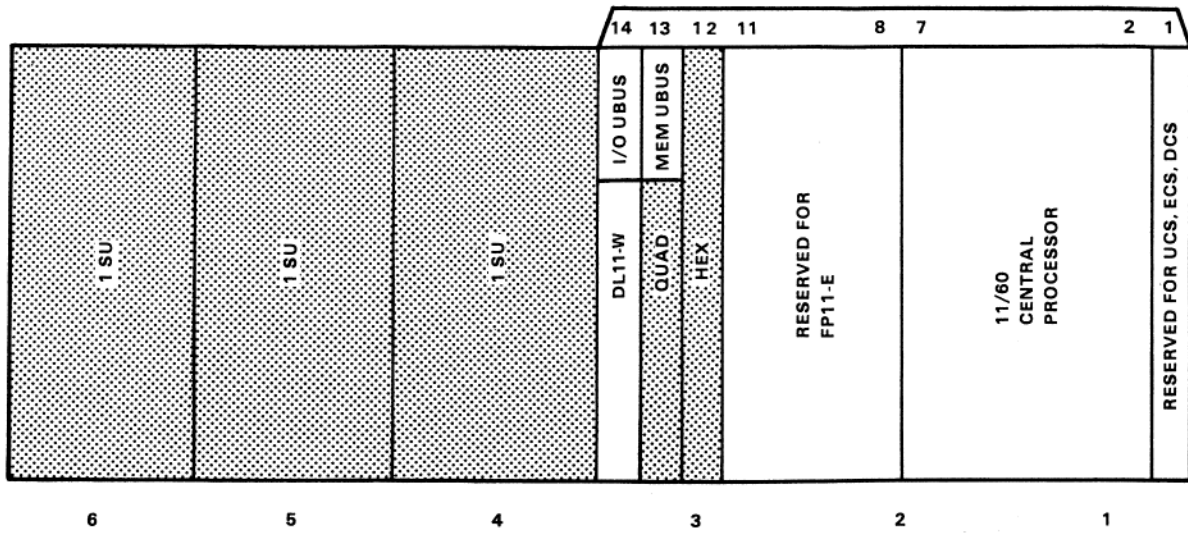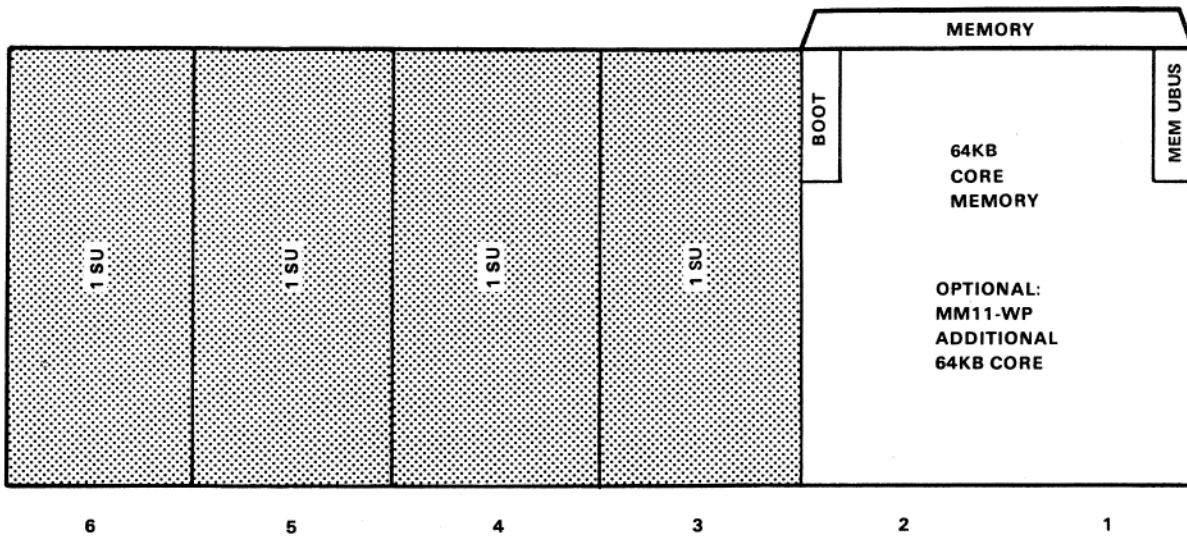
**BA11-P
(STANDARD)**

11X60-BA/BB Core, DWLB

22
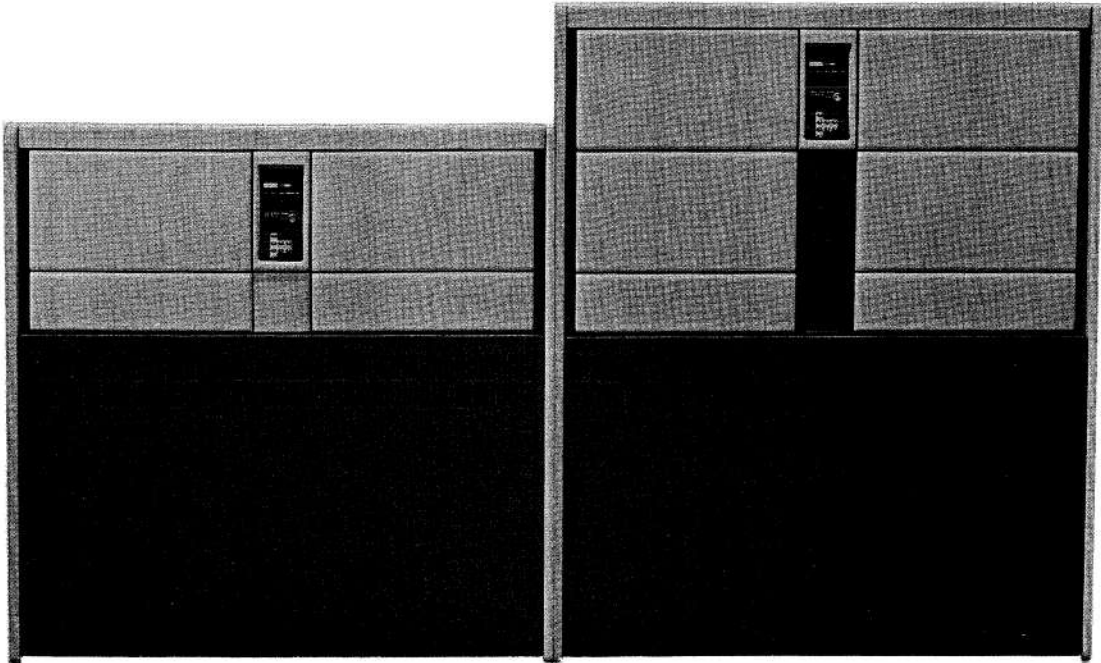
11X60 and 11Y60 Side-By-Side

**PDP-11/60-CA/CB (MOS) CABINETLESS BUILDING BLOCK
-BA/BB (Core) (See Table 1)**

For customers needing PDP-11/60 computing power but unable to use the furnished corporate cabinetry, the cabinetless PDP-11/60 is available in both MOS and core versions.

Both MOS and core versions are housed in the BA11-P CPU chassis and include 64 KB of memory, a DL11-WA, keypad console, and power supply already cabled in. The MOS version includes battery back-up. Both have a free quad slot and a free hex slot, plus space for a single system unit.
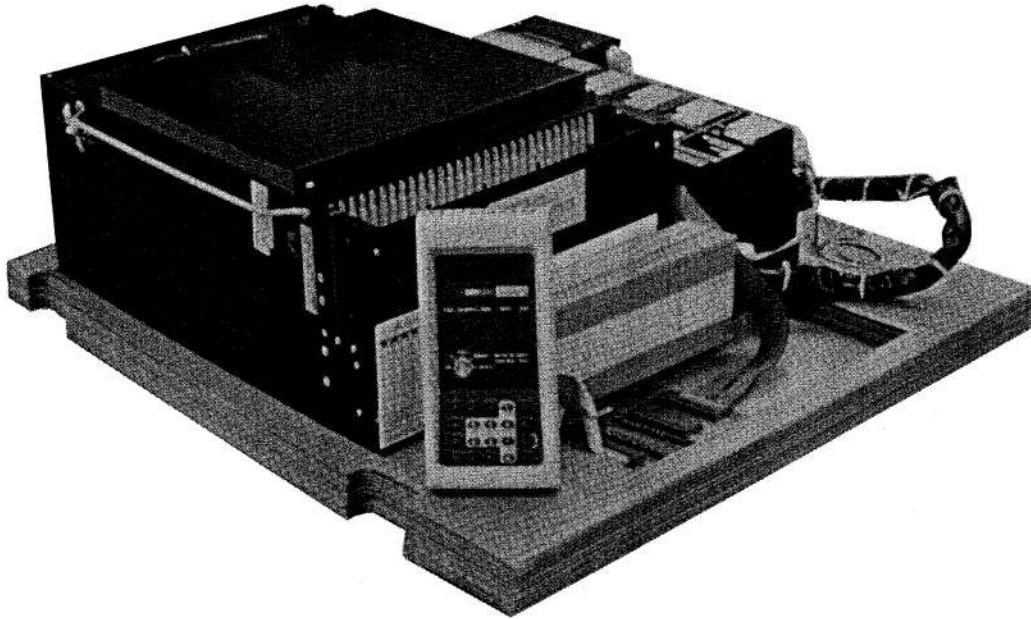
This PDP-11/60 configuration is limited to the following factory-installed options. (Additional options must be ordered as field-installed add-ons.)

KU116-AE/AT/AV	User Control Store
KU116-AB	Extended Control Store
KU116-BB	Diagnostic Control Store
FP11-EA/EB	Floating Point Processor
MM11-WP	64 KB Parity Core
MS11-KE/KF/KG	64 KB,128 KB,192 KB MOS/ECC

Logic Space

MOS memory configurations are arranged as shown on page 25.

Core memory configurations are arranged as shown on page 25.

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If a core system is to have more than 128 KB, all the core must be installed in an expander box during field installation. All core must be physically contiguous in that box. This frees two additional system units in the CPU box.

Note that the cabinetless PDP-11/60 does not come with a power control. Normally, cabinetry (including DIGITAL's) includes this unit, which provides:

1. Circuit breaker current overload protection

2. Low-level solenoids enabling the keypad console power key to control ac power service

3. Line filtering and spike suppression

If present cabinetry does not provide these functions, order as a separate line item any of the several power controls offered by DIGITAL. Please contact your DIGITAL Sales Representative for further information.
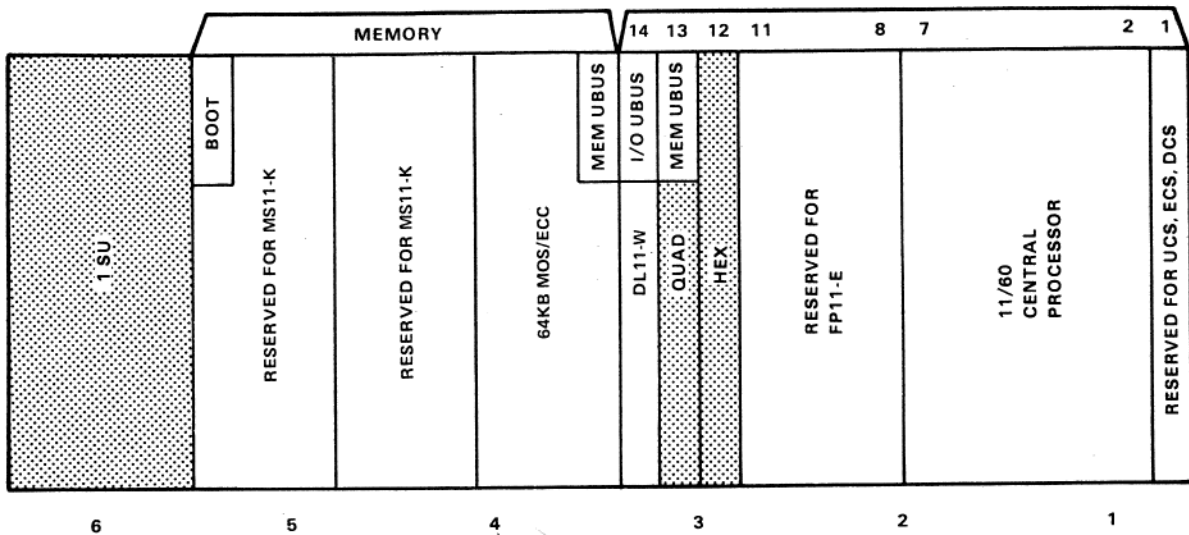
NOTE:
Shaded areas indicate available space.

11/60-CA/CB MOS Memory
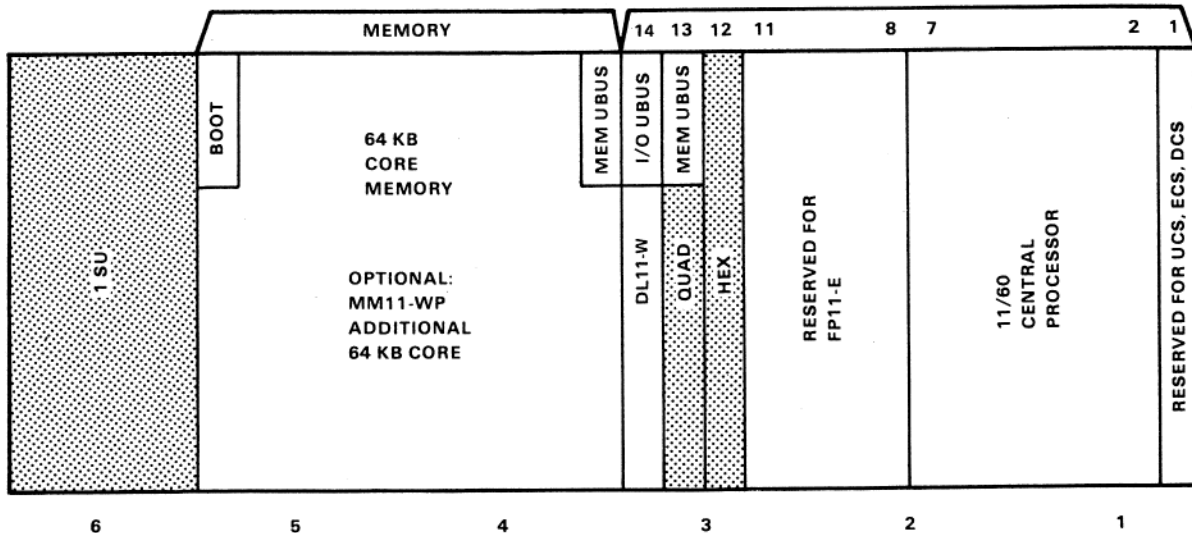
11/60-BA/BB Core Memory

PDP-11/60 OPTIONS

The following is a list of the options that are most frequently used in PDP-11/60 system configurations. If you have a requirement for something not listed here, contact your DIGITAL Sales Representative.

CPU Options

FP11-EA/EB	KU116-AB
Floating Point Processor	Extended Control Store
KU16-AE/AT/AV	KU116-BB
User Control Store	Diagnostic Control Store

Floating-Point Processing

Using the PDP-11/60's integral floating-point instructions, it is possible to run FORTRAN IV-PLUS (DIGITAL's fastest PDP-11 FORTRAN) without optional hardware. The 46 integral floating-point instructions perform arithmetic operations many times faster than software routines and provide a very cost-effective solution to most OEM needs. This complete instruction set includes the ability to convert between fixed-point and floating-point formats, so that the two types of computation can be used together.

OEMs who need optimum floating-point performance can order the FP11-E floating-point processor, a hardware option that plugs into four prewired slots in the PDP-11/60 CPU backplane. This unit requires no changes in software, and for many applications, can give PDP-11/60 FORTRAN throughput approaching that of the PDP-11/70. It is highly optimized to speed up the most frequently used operations, and it calculates independently of central processor operations, freeing the CPU to simultaneously perform non-floating-point computations.

With a dedicated set of six 64-bit accumulators, the FP11-E performs calculations in either single-precision (32 bits) or double-precision (64 bits). The unit provides results with either seven (single-precision) or 17 (double-precision) decimal digits of accuracy. The typical execution times for FP11-E floating-point calculations are listed below.

Execution Times for FP11-E Floating Point Calculations

Operation	Single-Precision	Double-Precision
Add/subtract	1.0 μs	1.0 μs
Multiply	1.53 μs	3.74 μs
Divide	7.0 μs	12.75 μs

Values shown are for register-register operations.

WCS Options

User microprogramming allows customizations of the computer for particular applications. There are two available options for OEMs who do their own microprogramming. The KU116-AE/AT/AV user control store (UCS) is designed to aid in the development and debugging of microcode. The KU116-AB extended control store (ECS) is intended for economical volume production or permanent non-destructive store of perfected microprograms. Both of these modules plug into slot 1 of the CPU backplane, and so only one option can be used at any one time.

User control store comes with Category C microprogramming tools for 128 KB or larger systems. It includes hardware, software, and programmer-oriented documentation. The writeable control store (WCS) board holds control logic and 1024 48-bit microwords of random access memory. Each microword can be used either as one 48-bit microinstruction or as three 16-bit data words. By storing frequently used data within the CPU in this fashion (called a local data store), the information can be retrieved at the 170 ns internal cycle time of the CPU.

Extended control store is a hardware-only option consisting of one board with control circuitry and chip sockets. The board can hold 1536 48-bit words of microcode in a customer-supplied ROM or PROM. To help you appreciate this enormous storage capacity, the entire built-in PDP-11/60 instruction set occupies less than 1.5K words of microcode. Because ECS programs cannot be changed easily, ROM chips should only be blasted once the microcode has been fully developed and debugged with the UCS option.

Diagnostic Control Store (DCS)

The PDP-11/60's most significant diagnostic advance is the DCS module, consisting of a fault dictionary and a single board that plugs into slot 1 of the CPU backplane. Its microprogrammed routines test five of the six CPU boards (cache has its own diagnostics) and can isolate fatal faults to the board level (or to single chips in some cases) in just a few seconds. Experience has shown that the DCS will locate a very high percentage of all CPU faults.

A single burst of 64 passes through the test sequence will usually isolate the fault. To find intermittent problems, DCS can run continuously during off-hours, until it is stopped by a malfunction. You can initiate tests either from the PDP-11/60 console or from a switch on the DCS board itself (if the console's viability is in question). Another switch allows on-board self-tests to verify that the DCS is working properly.

When tests are completed, indicator lights on the DCS display a code which the engineer looks up in a fault dictionary. This dictionary tells him which board or component is defective and allows him to make immediate repairs. If the tests find no problem, the PDP-11/60 console indicates that the system is ready to go.

DIGITAL Field Service engineers will carry the DCS module and it will be available to OEMs who want to maintain their own systems. To save service charges, the board's simple operation allows less sophisticated personnel to do the tests and to simply call in an order for necessary replacement parts.

Core Memory

The PDP-11/60 processor is also available with parity core memory (MF11-WP). The core memory system uses 64K byte stacks. A maximum of two stacks and associated control logic are contained in a double system unit backplane (2 SUs). Therefore, core memory systems of 128K bytes or less occupy 2 SUs and systems of more than 128K bytes occupy 4 SUs. With the exception of the Cabinetless PDP-11/60, core memory systems are configured with the memory in the expansion card cage. The location of the core memory relative to the PDP-11/60 processor is illustrated below. Note that systems with greater than 128K bytes of core memory require 4 SUs of mounting space. The memory cable specification requires that multiple core memory controllers be located together.

MOS Memory

The MOS memory error correcting code (ECC) logic detects all single-bit errors and automatically corrects them. Errors affecting more than a single bit are detected and a processor error trap is generated.

PDP-11/60 MOS memory includes a battery backup system. As long as ac power is available, the battery backup unit is recharging. When ac power is lost, the battery backup unit provides power to maintain the integrity of the data in the MOS memory (supports refresh cycles).

The MOS memory controller and space (slots) to mount up to 256K bytes of memory are contained in a prewired double system unit. It is mounted in the same card cage and adjacent to the PDP-11/60 processor backplane. The configuration of PDP-11/60 processor with MOS memory is shown below. All MOS memory configurations from 64K bytes to 256K bytes are contained in the processor backplane.

Memory Options

MS11-KE	64K Byte MOS Expansion
MS11-KF	128K Byte MOS Expansion
MS11-KG	192K Byte MOS Expansion
MM11-WP	64K Byte Core Expansion
MF11-WP	64K Byte Core Expansion with backplane
MF11-WS	128K Byte Core Expansion with backplane
MF11-WT	192K Byte Core Expansion with backplane

Expander Memory Selection Guide

MOS Memory

From	To 128 KB	To 192 KB	To 256 KB
64 KB	MS11-KE	MS11-KF	MS11-KG
128 KB	–	MS11-KE	MS11-KF
192 KB	–	–	MS11-KE

Core Memory

From	To 128 KB	To 192 KB	To 256 KB
64 KB	MM11-WP	MF11-WS	MF11-WT
128 KB	–	MF11-WP	MF11-WS
192 KB	–	–	MM11-WP

PDP-11/60 systems are available with two types of memory: MOS memory with error correcting code (ECC) and battery backup; or parity core memory. Note that MOS and core memories may not be mixed.

EXPANSION
SPACE

| MOS | 1 SU | MF11S-K MOS MEMORY 64, 128, 192 or 256K BYTES | 11/60 CPU |

EXPANSION CARD CAGE
(OPTIONAL)

CPU BA11-P

EXPANSION BA11-P

| CORE | EXPANSION SPACE | 11/60 CPU |

| | 3 SU | 3 SU |

| EXPANSION SPACE | MF11-WP EXPANSION SPACE FOR 192 OR 256K BYTES | MF11-WP CORE MEMORY 64 OR 128K BYTES |

| 2 SU | 4 SU |

2 SU
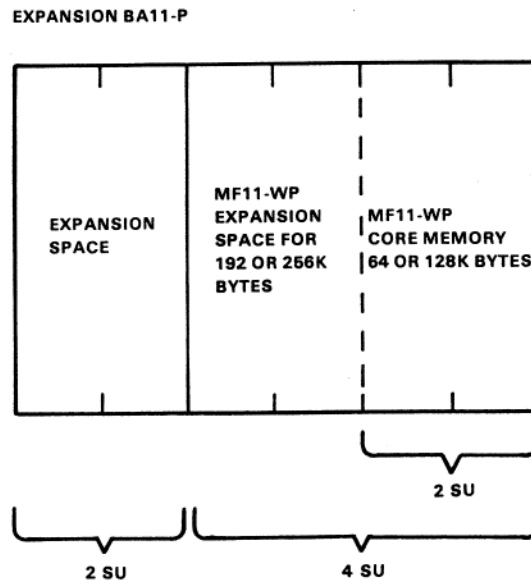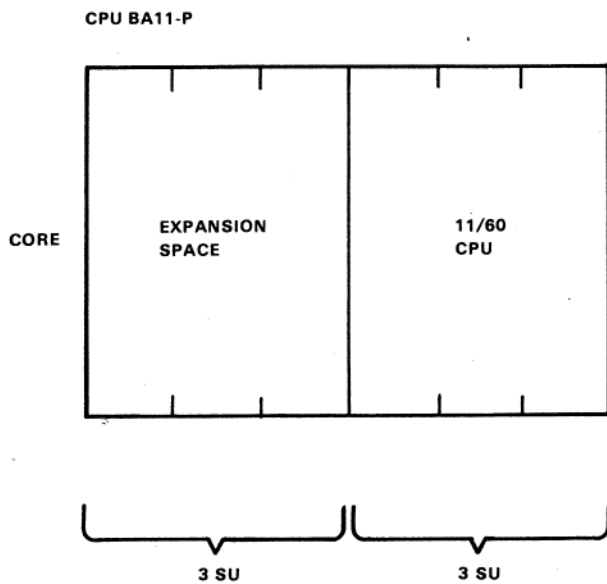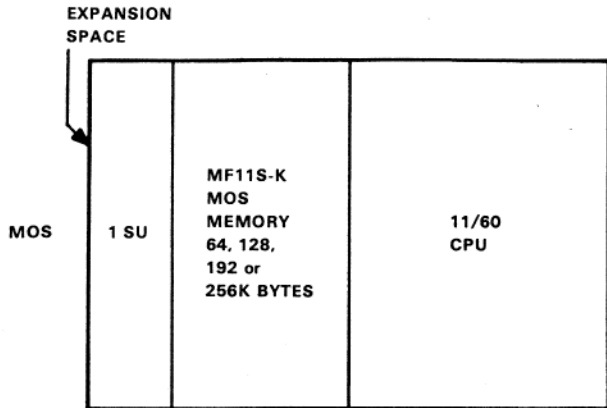
NOTE
ALL MOS MEMORY SYSTEMS REQUIRE 2 SU's. CORE MEMORY SYSTEMS OF 128K BYTES OR LESS REQUIRE 2 SU's, GREATER THAN 128K BYTES REQUIRE 4 SU's.

Basic CPU Physical Layout

EXPANSION CABINETS

There are four primary expansion cabinets available for PDP-11/60 systems:

H9600   Double-width highboy (DWHB)cabinet with three-phase power controller

H9601   Double-width lowboy (DWLB) cabinet with three-phase power controller

H9602   Single-width highboy (SWHB) cabinet with one-phase power controller

H9603   Single-width lowboy (SWLB) cabinet with one-phase power controller

High-boy Height

Low-boy Height

48.2 cm (19 in) RACK SPACE

48.2 cm (19 in) RACK SPACE

48.2 cm (19 in) RACK SPACE

48.2 cm (19 in) RACK SPACE

BELTLINE

48.2 cm (19 in) RACK SPACE

48.2 cm (19 in) RACK SPACE

48.2 cm (19 in) RACK SPACE

48.2 cm (19 in) RACK SPACE

POWER CONTROL

CASTERS

FRONT VIEW

DOUBLE-WIDTH

REAR VIEW

High-boy Height

Low-boy Height

48.2 cm (19 in) RACK SPACE

48.2 cm (19 in) RACK SPACE

BELTLINE

48.2 cm (19 in) RACK SPACE

48.2 cm (19 in) RACK SPACE

POWER CONTROL

CASTERS

FRONT VIEW

SINGLE-WIDTH

REAR VIEW

PDP-11/60 Expansion Cabinets

Double-Width Cabinets

The double-width cabinets are identical to the PDP-11/60 system cabinet except the space below the belt line is not limited to installation of logic card cages. Expansion cabinets have 48.3 cm (19 in) racks on each side below the belt line. Either or both of the inside rails may be removed and a BA11-P logic card cage installed. Therefore, a double-width expansion cabinet may be configured with one or two BA11-P card cages, or the area may be used to mount 48.3 cm (19 in) of equipment. This area is covered by a full-width cover panel and therefore is not appropriate for operator-accessible equipment.

The space above the belt line is for mounting fixed or slide-mounted operator-accessible equipment. All equipment above the belt line is visible and accessible from the front. In the high-boy cabinet there are 66.7 cm (26.2 in) of vertical mounting space; in the lowboy there are 40.0 cm (15.7 in). There are 48.3 cm (19 in) above the belt line which can support options with a front-to-rear depth of 63.5 cm (25 in).

Below the belt line in the rear there are 48.3 cm (19 in) of rack space on the right side. The lower 13.3 cm (5.2 in) of this area are reserved for the ac power controller. If there is no BA11-P in front of this area, full depth 63.5 cm (25 in) rack-mount equipment may be mounted here. Equipment mounted here is not exposed to view when the front panel is in place.

If a double-width expansion cabinet contains no BA11-P expansion boxes, vertical space below the belt line is general purpose, 48.3 cm (19 in) wide mounting space. Installation of the first expansion BA11-P utilizes 48.3 cm (19 in) of mounting space in two areas. First, rail space at the front of the cabinet on whichever side the BA11-P has been installed ceases to be available. Second, the rail space at the left side of the cabinet as seen from the rear is replaced by special 63.5 cm (25 in) wide racks to accommodate the power supply associated with the BA11-P. Installation of a second expansion BA11-P utilizes the remaining below-the-belt line space in the front on the other side.

Single-Width Cabinets

The single-width expansion cabinet can be considered as the left half of a double-width cabinet as seen from the front, with some minor changes. It is more than half the width of the double cabinet; the center space of the double-width cabinet is on the right side of the single cabinet. This space is required for mounting an optional BA11-P expander box.

The space above the belt line has 48.3 cm (19 in) racks, front and back. The height of this space is 40.0 cm (15.7 in) for the lowboy and 66.7 cm (26.2 in) for the highboy.

Connecting Expansion Cabinets to System Cabinets

The lowboy expansion cabinets, after the sides are removed, bolt to the side of the PDP-11/60 system cabinet. The end panels are then bolted to the end of the system configuration.

CURRENT AVAILABLE:		DD11-CF	OCCUPIES 1 SU	DD11-DF	OCCUPIES 2 SU
SU 1&2 25 A @ +5 V	SU 5&6 16 A @ +5 V		PROVIDES BACKPLANE FOR		PROVIDES BACKPLANE FOR
SU 3&4 25 A @ +5 V	SU 1→6 4 A @ −15 V		(2) QUAD SPC		(2) QUAD SPC
			(20 HEX SPC		(7) HEX SPC
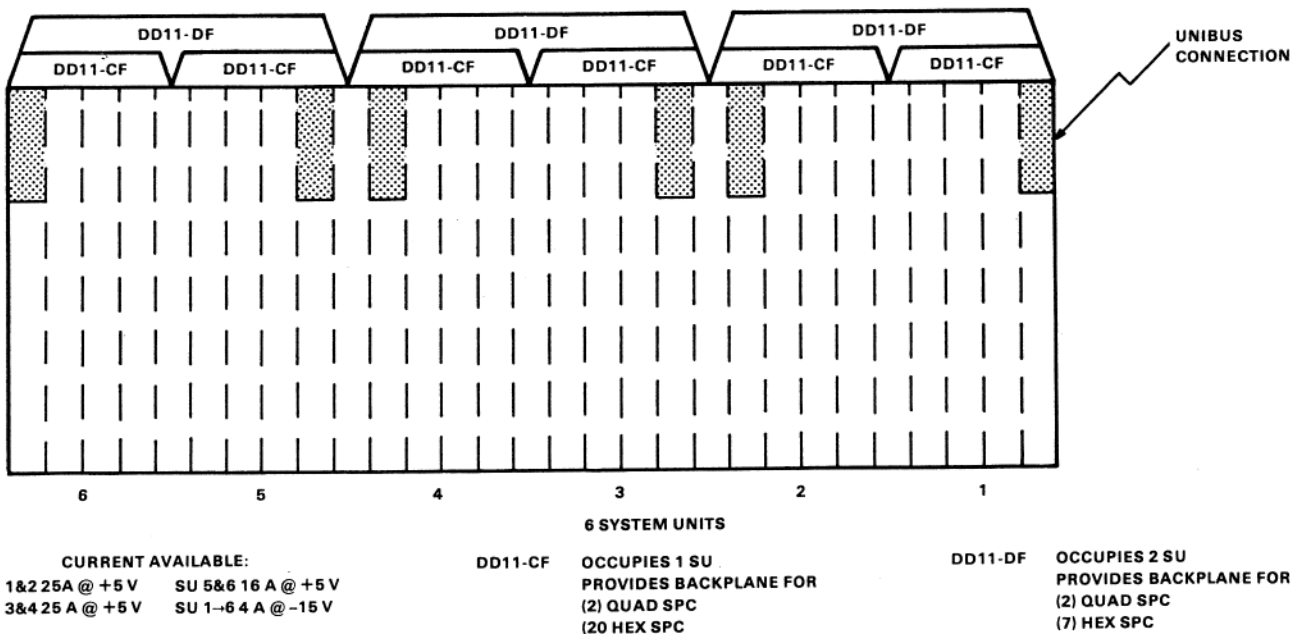
NOTE
TO MOUNT SPC PERIPHERAL CONTROLLERS IN BA11-PE(F) CARD CAGES A DD11-DF OR DD 11-CF BACKPLANE MUST BE PROVIDED.

BA11-PE,PF Configurator

No special panels are required to connect highboy to highboy or lowboy to lowboy. Some configurations will contain lowboy system cabinets with highboy expansion. These cabinets also bolt together but the system cabinet end panel will not fit the side of the highboy expansion cabinet. In addition, a 26.7 cm (10.5 in) section of the highboy cabinet is exposed above where it is bolted to the lowboy cabinet. Please order H9504-CA and H9504-XD, respectively, to cover these spaces.

Expansion Hardware

Model	Description
H9600-AA	DWHB expansion cabinet with 3-phase power control, 115 V, 60 Hz
H9600-AB	DWHB expansion cabinet with 3-phase power control, 230 V, 50 Hz
H9601-AA	DWLB expansion cabinet with 3-phase power control, 115 V, 60 Hz
H9602-BA	SWHB expansion cabinet with 1-phase power control, 115 V, 60 Hz
H9602-BB	SWHB expansion cabinet with 1-phase power control, 230 V, 50 Hz
H9603-BA	SWLB expansion cabinet with 1-phase power control, 115 V, 60 Hz
H9603-BB	SWLB expansion cabinet with 1-phase power control, 230 V, 50 Hz
H9603-CA	SWLB expansion cabinet without power control
BA11-PE	Expansion chassis with power supply, 115 V, 60 Hz
BA11-PF	Expansion chassis with power supply, 230 V, 50 Hz
H9504-CA	Highboy end panel
H9504-DA	Lowboy end panel
H9504-XD	Trim piece for HB mounted to LB

MODEL	DESCRIPTION
DD11-DF	Nine-slot backplane, accommodates seven hex and two quad SPC modules; occupies 2 SUs
DD11-CF	Four-slot backplane, accommodates two hex and two quad SPC modules; occupies 1 SU
M9202	Unibus jumper module

PDP-11/60 SITE PREPARATION

Cooling Requirements
The PDP-11/60 computer and expansion cabinets are designed to house equipment that is self-cooled. The upper section of each cabinet is restricted to mounting peripheral devices with front to back air flow. The lower section will also accommodate such devices but is best suited to the BA11-PE card cage or other equipment which draws air in at the belt line and exhausts it at the bottom of the cabinet.

PDP-11/60 Power Requirements
Each PDP-11/60 system cabinet has a three-phase power controller to provide adequate power for all options included in the cabinet. Ten switched outlets are operated from the key switch on the computer console. Four outlets are unswitched. All 14 outlets are single-phase. Each phase will provide 24 A of 120 Vac or 12 A of 240 Vac. Load balancing is performed within the cabinet by connecting card cages and peripherals to outlets of different phases.

The main power feed should be either:

30 A, 120/208 Vac, three-phase, wye-connected, four-wire plus ground,

or

20 A, 240/416 Vac, three-phase, wye-connected, four-wire plus ground.

The voltage terminology 115/208 Vac refers to the single-phase line-to-neutral voltage of 120 Vac and between phase voltage of 208 line-to-line Vac. The power controller distributes single-phase power. Phase balancing is done by connecting options to different phases.

Double-width expansion cabinets are also configured with a three-phase power controller. Single-width cabinets are configured with single-phase power controllers (30 A at 120 Vac, 20 A at 240 Vac).

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Wall Power Specifications for PDP-11/60 Cabinets

Source	Cabinet Type	NEMA Plug Number	NEMA Receptacle Number
30 A, 120/208 Vac, 3-phase	Double-width cabinets	L21-30P	L21-30R
20 A, 240/416 Vac, 3-phase		L22-20P	L22-20R
30 A, 120 Vac, 1-phase	Single-width cabinets	L5-30P	L5-30R
20 A, 240 Vac, 1-phase		L6-20P	L6-20R
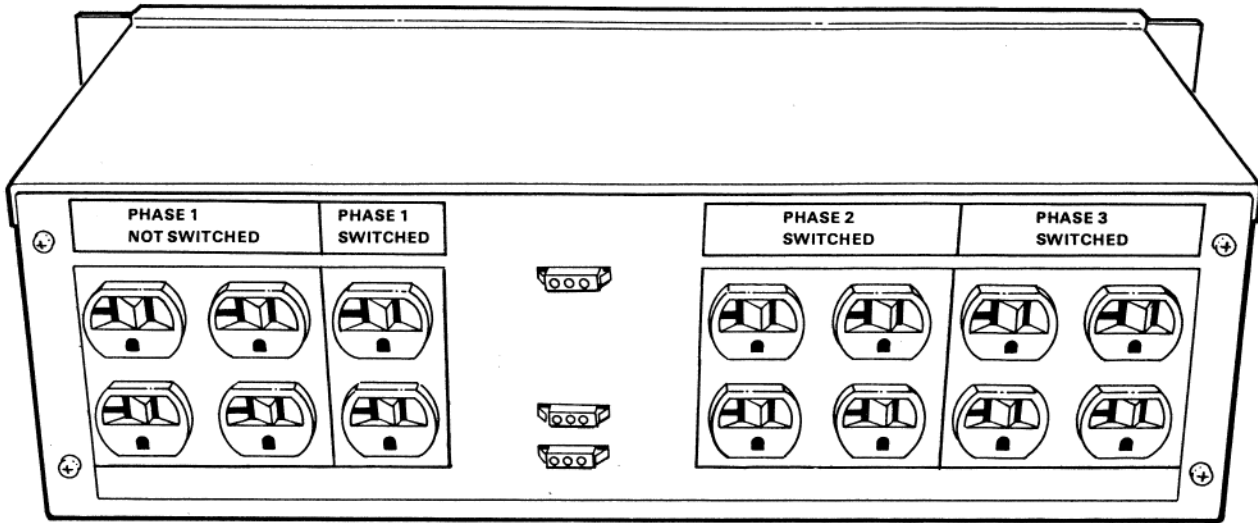
Basic NORAM 120/60 Cycle Convenience Outlet
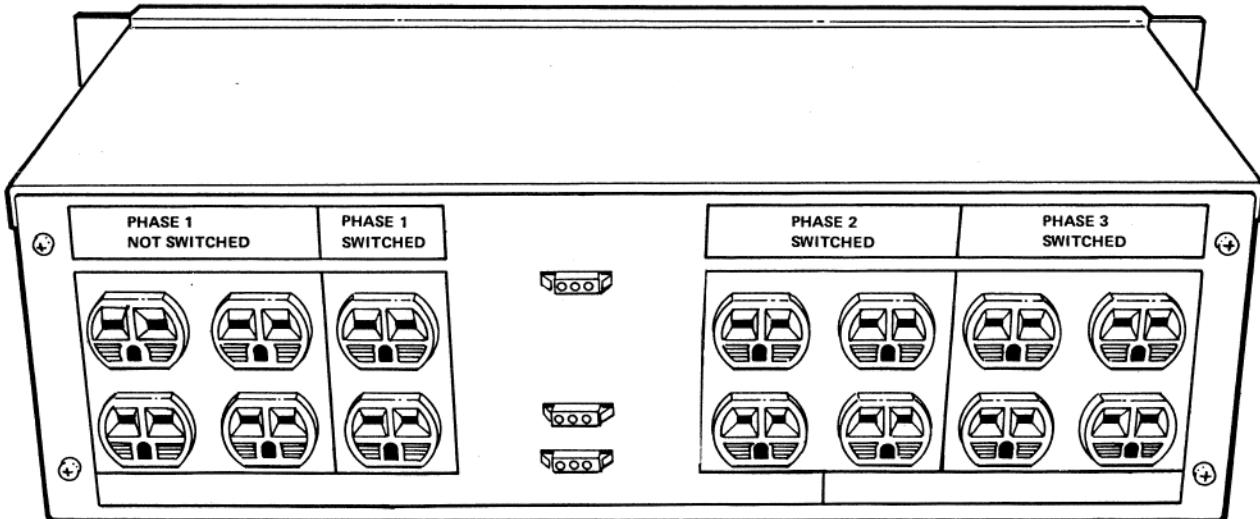
Basic European 240/50 Cycle Convenience Outlet

PDP-11/60 General Specifications

Instructions	Basic PDP-11 set plus XOR, SOB MARK, SXTA, RTT, FP11-C floating-point instruction set: MED EIS-MUL, DIV, ASH, ASHC Memory management set – MFPI, MTPL, MPPD, MTPD
Programming modes	User and kernel
General registers	8
Pushdown stack limit address	Programmable
Word size	16-bit
Interrupt structure	Automatic hardware interrupts, four priority levels
Floating-point capability standard	FP11-C equivalent instruction set built-in FP11-E processor option
Microprogramming options	User Control Store – 1K × 48-bit words (RAM), includes board, software, and documentation Extended Control Store – 1.5K × 48-bit word capacity (board contains sockets for ROM or PROM) Diagnostic Control Store – 1.5K × 48-bit words (ROM): includes board and fault directory
Cache memory	2048 bytes; bipolar, directly-mapped cycle time 340 ns, typical hit ratio 87 percent assuming mix of 90 percent reads and 10 percent writes
Data transmission	Asynchronous, via Unibus
Bootstrap unit	M9312, standard: suports disk drives, floppy, cartridge, or pack, tape drives, and paper tape reader

Main Memory

Types	MOS (MF11S-KF)	(Core MF11-WP)
Speed	800 ns read 1200 ns write	read access 625 ns full cycle 1200 ns
Effective cycle time of CPU, cache, memory	Approx. 490 ns	approx. 530 ns

Error checking	Error Correcting Code	Parity
Battery backup	Standard	Not needed

Maximum size	256K bytes (248K usable) in 64 KB increments, both MOS and core
System weights	Approx. 241 kg (530 lbs) (Building Block) to approx. 723 kg (1590 lbs) (RP06/TE16)
Operating temperature	10°–40° C (50°–104° F)
Relative humidity	20–80 percent (non-condensing)
Maximum heat dissipation	Approx. 15,000 to Btu/h (Building Block) to approx. 27,000 Btu/h (RP06/TE16)
Electrical	UL listed
Power Control	One three-phase power controller services three separate single-phase power supplies

Power requirements	North American	European
Three-phase wye	120/208 Vac 24 A/phase 60 or 50 Hz	240/416 Vac 12 A/phase 50 or 60 Hz
Plug – three-phase, five-wire	NEMA L21-30P	NEMA L22-20P
Power cable length	4.6 m (15 ft)	4.6 m (15 ft)
Power requirement for cabinetless PDP-11/60	115 or 230 single-phase; polarized plug	47–63 Hz; three-wire single-phase
Plug for cabinetless PDP-11/60	NEMA L5-15P	NEMA L6-15P

Table 1 PDP-11/60 Configurations

Model	Memory	Mass Storage	CPU Cabinet	Logic CPU Box Space	Expansion Available +5 V	Expansion Box Space	+5 V	Unibus Loads Available	Cabinet Space Available	Installed Weight kg (lb)
PACKAGED SYSTEMS										
SM-60CVB	128K bytes MOS	RP06 (free-standing) TE16 (SWHB)	DWHB	1 SU 1 hex 1 quad SPC	23.5	2 SUs	15.0	13	4-L pan 2-S pan	770 (1700)
SM-60UVA	128K bytes MOS	RM02 (free-standing) TE16 (SWHB)	DWHB	1 SU 1 hex 1 quad	23.5	2 SUs	15.0	13	4-L pan 2-S pan	680 (1500)
SM-60HHA	128K bytes MOS	2 RK07s free-standing	DWHB	1 SU 1 hex 1 quad	23.5	4 SUs 2 hex 1 quad	51.7	14	4-L pan 2-S pan	470 (1040)
SM-60HHB	128K bytes MOS	2 RK07s cab-mounted	DWLB	1 SU 1 hex 1 quad	23.5	4 SUs 2 hex 1 quad	51.7	14	None	420 (930)
SM-60KKA	128K bytes MOS	2 RK06s cab-mounted	DWLB	1 SU 1 hex 1 quad	23.5	4 SUs 2 hex 1 quad	51.7	14	None	420 (930)
SM-60LLA	128K bytes MOS	2 RL01s cab-mounted	DWHB	2 hex 3 quad	17.2	6 SUs	65.0	14	2-L pan 2-S pan	180 (400)
BUILDING BLOCK SYSTEMS										
11X60-BA/BB	64K bytes Core	None	DWLB	3 SUs 1 hex 1 quad	30.2	4 SUs	40.0	14	2-L pan 2-S pan	250 (560)
11X60-CA/CB	64K bytes MOS	None	DWLB	1 SU 1 hex 1 quad	23.5	6 SUs	65.0	15	2-L pan 2-S pan	250 (530)
11Y60-BA/BB	64K bytes Core	None	DWHB	3 SUs 1 hex 1 quad	30.2	4 SUs	40.0	14	4-L pan 2-S pan	250 (560)
11Y60-CA/CB	64K bytes MOS	None	DWHB	1 SU 1 hex 1 quad	23.5	(Optional) 6 SUs	65	15	4-L pan 2-S pan	240 (530)
11/60-BA/BB	64K bytes Core	None	None	1 SU 1 hex 1 quad	8.4	N/A	N/A	14	N/A	70 (150)
11/60-CA/CB	64K bytes MOS	None	None	1 SU 1 hex 1 quad	23.5	N/A	N/A	15	N/A	70 (150)
H950-WA/WB	Bracket kit for mounting cabinetless PDP-11/60 in H960.									
H960-HA/HB	H960 cabinet with modified door and H950-WA/WB, for cabinetless PDP-11/60.									

Table 2   Disk Options

Option	Description	Capacity (M Bytes)	Average Access Time(ns)	Peak Transfer Rate(KB/s)	Device Mounting	Dual Port Versions Available	Logic Mounting Space	Unibus Loads	+5 V Current Required
RJP06-AA/AB	Disk and controller	176	36.3	806	Free-standing	Yes	2 SUs	1	16.0
RP06-AA/AB	Expansion disk	176	36.3	806	Free-standing	Yes	–	–	–
RJM02-AA/AD	Disk and controller	67	38.3	806	Free-standing	Yes	2 SUs	1	16.0
RM02-AA/AD	Expansion disk	67	38.3	806	Free-standing	Yes	–	–	–
RK711-EA/ED	Disk and controller	28	49.0	538	*	Yes	2 SUs	1	15.0
RK07-EA/ED	Expansion disk	28	49.0	538	*	Yes	–	–	–
RK611-EA/ED	Disk and controller	14	50.5	538	*	Yes	2 SUs	1	15.0
RK06-EA/ED	Expansion disk	14	50.5	538	*	Yes	–	–	–
RL11-AK	Disk and controller	5.2	67.5	512	1 large pan	No	1 hex	1	2.5
RL01-AK	Expansion disk	5.2	67.5	512	1 large pan	No	–	–	–
RX11-BA/BD	Dual diskette	0.512	501.4	31	1 large pan	No	1 quad	1	1.5

*When purchased separately it is free-standing, but as a component in SM-60HHB or SM-60KKA systems the disk devices are mounted in the cabinets.

Table 3   Magnetic Tape Options*

Option	Description	Speed (in/s)	Density(bpi) (bits/in)	Tracks	Capacity (M Bytes)	Device Mounting	Logic Mounting	Unibus Loads	Current at 5 V
TJE16-AA/AD	Tape drive and controller	45	800/1600	9	17/26	H9502	2 SUs	1	16
TE16-AE/AJ	Expansion tape drive	45	800/1600	9	17/26	H9502	None	None	None
TME11-AA/AD	Tape drive and controller	45	800	9	17	H9502	1 SU	1	5
TE10W-AE/AJ	Expansion tape drive	45	800	9	17	H9502	None	None	None
TMB11-MA/MB	Tape drive and controller	12.5	800	9	4.1	1 large pan	1 SU	1	5
TS03-SA/SB	Expansion tape drive	12.5	800	9	4.1	1 large pan	None	None	None

*Stand-alone tape drives (TE16 and TE10W) are packaged in the H9502 cabinet. This cabinet is a SWHB (single-width highboy) expander cabinet. No other options can be mounted in the tape cabinet. Mechanically, it is not possible to mount a TE16 or a TE10W in any dual cabinet.

The TS03 magnetic tape does not come in a cabinet. A TS03 requires 26.2 vertical cm (10.5 in) above the beltline. [It occupies space normally covered by a 26.2 cm (10.5 in) bezel.]

Table 4 Communications Options

Option	Description	Mounting Code	Requisites	+5 V Used	Unibus Loads	Comments
DMC11-AL (local) -AR (remote)	Serial network link	1 hex	None	5.0	1	
DMC11-MA (1M bit/s) -MD (56K bit/s)	Local interface unit for DMC11-AL	1 hex	Must mount next to DMC11-AL	2.5	0	Will mount in quad slot below Unibus connector.
DMC11-DA (FA)	Remote interface unit for DMC11-AR	1 hex	Must mount next to DMC11-AR	2.5	0	Will mount in quad slot below Unibus connector.
DN11-AA, DN11-DA	Auto-dial interface	1 SU	Serial line interface	1.0	1	
DQ11-DA	Synchronous line controller (NPR)	1 SU	None	5.7	1	
DUP11-DA	Synchronous line controller (interrupt)	1 hex	None	3.6	1	
DV11 Series	16-line synchronous line multiplexer	2 SUs	None	12.3	2	Requires communication distribution panel.
DZ11 Series	8-line asynchronous line multiplexer	1 hex	None	3.0	1	Requires communication distribution panel.
DH11-AA (AC)	16-line asynchronous line multiplexer	2 SUs	None	8.4	2	Requires *special* distribution panel.
DH11-AD (AE)	Same	2 SUs	None	10.8	2	Requires communication distribution panel; DM11-AE is 3-unit bus.
DL11-W Series	Asynchronous line interface	1 quad	None	2.0	1	
KG11-A	CRC checker	1 quad	None	1.5	1	
KMC11-A	Auxiliary processor	Hex SPC	None	5.0	1	

Table 5 General Interface and Unit Record Options

Model	Description	Mounting Code	Prerequisite	+5V Used	Unibus Loads
CR11/CR11-A	Card reader	1 Quad	None	1.5	1
DB11-A	Unibus Repeater	1 SU	None	3.2	1
DR11-B	General Interface NPR Control	1 SU	None	3.3	1
DR11-C	General Interface Program Control	1 Quad	None	2.5	1
LP11-VA/VB	Line Printer, 300 lines/ min	1 Quad	None	1.5	1